

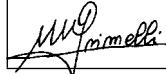
# WORKSHOP MANUAL

Engine Series 3 - 4 LD



## REGISTRATION OF MODIFICATIONS TO THE DOCUMENT

Any modifications to this document must be registered by the drafting body, by completing the following table.

Drafting body	Document code	Model N°	Edition	Revision	Issue date	Review date	Endorsed
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### Manual's purpose

- This manual contains the instructions needed to carry out a proper maintenance of the engine, therefore it must always be available, for future reference when required.
- Safety pictograms can be found on the engine and it is the operator's responsibility to keep them in a perfectly visible place and replace them when they are no longer legible.
- Information, description and pictures in this manual reflect the state of the art at the time of the marketing of engine.
- However, development on the engines is continuous. Therefore, the information within this manual is subject to change without notice and without obligation.
- **LOMBARDINI srl** reserves the right to make, at any time, changes in the engines for technical or commercial reasons.
- These changes do not require **LOMBARDINI srl** to intervene on the marketed production up to that time and not to consider this manual as inappropriate.
- Any additional section that **LOMBARDINI srl** will deem necessary to supply some time after the main text shall be kept together with the manual and considered as an integral part of it.
- The information contained within this manual is the sole property of **LOMBARDINI srl**. As such, no reproduction or replication in whole or part is allowed without the express written permission of **LOMBARDINI srl**.

## PREFACE

Every attempt has been made to present within this use and maintenance, accurate and up to date technical information. However, development on the Lombardini series is continuous.

Therefore, the information within this manual is subject to change without notice and without obligation.

Carefully read and follow all instructions in this booklet as well as all those provided with the equipment on which this engine is used. The information contained within this service manual is the sole property of Lombardini.

As such, no reproduction or replication in whole or part is allowed without the express written permission of Lombardini.

Information presented within this manual assumes the following the person or persons performing service work on Lombardini series engines:

1 - is properly trained and equipped to safely and professionally perform the subject operation;

2 - possesses adequate hand and Lombardini special tools to safely and professionally perform the subject service operation;

3 - has read the pertinent information regarding the subject service operations and fully understands the operation at hand.

- For spare parts and after sale assistance contact authorized service centers.
- For any spare parts order please specify following details: ENGINE TYPE AND SERIAL NUMBER
  - Version (K) - on the engine name plate
- Tel. No. appears on service booklet or on the website: [www.lombardinigroup.it](http://www.lombardinigroup.it)
- Pls contact Service Centers for special applications.



## GENERAL SERVICE MANUAL NOTES

1- Use only genuine repair parts. Failure to use genuine parts could result in sub-standard performance and low longevity.

2- All data presented are in metric format:

- . dimensions are presented in millimeters (mm),
- . torque is presented in Newton-meters (Nm),
- . weight is presented in kilograms (kg),
- . volume is presented in liters or cubic centimeters (cc)
- . pressure is presented in barometric units (bar).

3- To ensure safe operation please read the following statements and understand their meaning.  
Also refer to your equipment manufacturer's manual for other important safety information.

This manual contains safety precautions which are explained below.

-  **WARNING** Warning is used to indicate the presence of a hazard that can cause severe personal injury, death, or substantial property damage if the warning is ignored.
-  **IMPORTANT** This indicates particularly important technical information that should not be ignored.
-  **CAUTION** Caution is used to indicate the presence of a hazard that will or can cause minor personal injury or property damage if the caution is ignored.

## GLOSSARY AND TERMINOLOGY

For clarity, here are the definitions of a number of terms used recurrently in the manual.

- **Cylinder number one:** is the timing belt side piston .
- **Rotation direction:** anticlockwise «viewed from the flywheel side of the engine».

This handbook provides the main information concerning the repair of the following LOMBARDINI Diesel engines **3LD 450**, **3LD 510**, **3LD 451/S**, **3LD 510/S**, **4LD 640**, **4LD 705**, **4LD 820**, which are air-cooled, provided with direct injection and revised on the 15-06-2014.

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This manual contains safety precautions which are explained below.



### WARNING

Warning is used to indicate the presence of a hazard that can cause severe personal injury, death, or substantial property damage if the warning is ignored.



### CAUTION

Caution is used to indicate the presence of a hazard that will or can cause minor personal injury or property damage if the caution is ignored.



### IMPORTANT

This indicates particularly important technical information that should not be ignored.

## SAFETY INFORMATION

### GENERAL NOTES

- Lombardini engines are built to provide safe and longlasting performances, but in order to obtain these results it is essential that the maintenance requirements described in the manual are observed along with the following safety recommendations.
- The engine has been built to the specifications of a machine manufacturer, and it is his responsibility to ensure that all necessary action is taken to meet the essential and legally prescribed health and safety requirements. Any use of the machine other than that described cannot be considered as complying with its intended purpose as specified by Lombardini, which therefore declines all responsibility for accidents caused by such operations.
- The following instructions are intended for the user of the machine in order to reduce or eliminate risks, especially those concerning the operation and standard maintenance of the engine.
- The user should read these instructions carefully and get to know the operations described. By not doing so he may place at risk his own health and safety and that of anyone else in the vicinity of the machine.
- The engine may be used or mounted on a machine only by personnel suitably trained in its operation and aware of the dangers involved. This is particularly true for standard and, above all, special maintenance work. For special maintenance contact personnel trained specifically by Lombardini. This work should be carried out in accordance with existing literature.
- Lombardini declines all responsibility for accidents or for failure to comply with the requirements of law if changes are made to the engine's functional parameters or to the fuel flow rate adjustments and speed of rotation, if seals are removed, or if parts not described in the operating and maintenance manual are removed and reassembled by unauthorized personnel.



### WARNING

- In addition to all other machine specifications, ensure that the engine is in a near horizontal position when starting. If starting manually, ensure that the necessary operations can be performed without any risk of striking against walls or dangerous objects. Rope starting (except for recoil rope starting) is not permitted even in emergencies.
- Check that the machine is stable so that there is no risk of it overturning.
- Get to know the engine speed adjustment and machine stop operations.
- Do not start the machine in closed or poorly ventilated

environments. The internal combustion process generates carbon monoxide, an odourless and highly toxic gas, so spending too long a time in an environment where the engine discharges its exhaust products freely can lead to loss of consciousness and even death.

- The engine may not be used in environments containing flammable materials, explosive atmospheres or easily combustible powders, unless adequate and specific precautions have been taken and are clearly stated and certified for the machine.
- To prevent the risk of fire, keep the machine at a distance of at least one metre from buildings or other machines.
- Children and animals must be kept at a sufficient distance from the machine to prevent any danger resulting from its operation.
- Fuel is flammable, so the tank must be filled only when the engine is turned off. Dry carefully any fuel that may have spilled, remove the fuel container and any cloths soaked in fuel or oil, check that any sound-absorbing panels made of porous material are not soaked with fuel or oil, and make sure that the ground on which the machine is located has not absorbed fuel or oil.
- Before starting, remove any tools that have been used for carrying out maintenance work to the engine and/or the machine and check that any guards removed have been replaced. In cold climates it is possible to mix kerosene with the diesel fuel to make the engine easier to start. The liquids must be mixed in the tank by pouring in first the kerosene and then the diesel fuel. Consult Lombardini technical office for mixture proportions. Petrol may not be used because of the risk of it forming flammable vapours.
- During operation the surface of the engine reaches temperatures that may be dangerous. Avoid in particular all contact with the exhaust system.
- The liquid cooling circuit is under pressure. Do not carry out any checks before the engine has cooled down, and even then open the radiator cap or the expansion tank cautiously. Wear protective clothing and glasses. If there is an electric fan, do not approach the engine while it is still hot as the fan may come on even when the engine is not running. Clean the cooling system with the engine turned off.
- While cleaning the oil bath air filter, check that the oil is disposed of in such a way as not to harm the environment. Any filtering sponges in the oil bath air filter should not be soaked with oil. The cyclone pre-filter cup must not be filled with oil.
- Since the oil must be emptied out while the engine is still hot (approx. 80°C), particular care should be taken in order to avoid burns. In any case make sure that oil does not come into contact with your skin because of the health hazards involved.
- Fuel vapours are highly toxic, so fill up only in the open air or in well ventilated environments.

- During operations which involve access to moving parts of the engine and/or removal of the rotary guards, disconnect and insulate the positive cable of the battery so as to prevent accidental short circuits and activation of the starter motor.
- Check the belt tension only when the engine is turned off.

**IMPORTANT**

- To start the engine follow the specific instructions provided in the engine and/or machine operating manual. Do not use auxiliary starting devices not originally installed on the machine (e.g. Startpilot systems which utilise ether etc.)
- Before carrying out any work on the engine, turn it off and allow it to cool down. Do not perform any operation while the engine is running.
- Check that the discharged oil, the oil filter and the oil contained in the oil filter are disposed of in such a way as not to harm the environment.
- Close the fuel tank filler cap carefully after each filling operation. Do not fill the tank right up to the top, but leave sufficient space to allow for any expansion of the fuel.
- Do not smoke or use naked flames while filling.
- Take care when removing the oil filter as it may be hot.
- The operations of checking, filling up and replacing the cooling liquid must be carried out with the engine turned off and cold. Take particular care if liquids containing nitrites are mixed with others not containing these compounds as this may give rise to the formation of nitrosamines which are a health hazard. The cooling liquid is polluting, so dispose of in a manner that does not damage the environment.

**Regulations for lifting the engine**



- Before removing the engine from the vehicle on which it is installed, disconnect the power supply, detach the fuel and coolant supply, and all connections including the mechanical ones.
- Attach the engine to a suitable lifting device (lifting beam).
- To move the engine simultaneously use the eyebolts installed, these lifting points are not suitable for the entire machine, then use the eyebolts installed by the manufacturer.
- Before lifting, make sure the weight is correctly balanced by checking its barycentre.
- Close all engine openings accurately (exhaust, intake, etc.), then wash the outside and dry with a jet of compressed air.

**California Proposition 65  
WARNING**

*Engine exhaust from this product contains chemicals known to the State of California to cause cancer, birth defects, or other reproductive harm.*

## GENERAL SAFETY DURING OPERATING PHASES

- The procedures contained in this manual have been tested and selected by the manufacturer's technical experts, and hence are to be recognised as authorised operating methods.
- A number of procedures must be carried out with the aid of equipment and tools that simplify and improve the timing of operations.
- All tools must be in good working condition so that engine components are not damaged and that operations are carried out properly and safely.  
It is important to wear the personal safety devices prescribed by work safety laws and also by the standards of this manual.
- Holes must be lined up methodically and with the aid of suitable equipment. Do not use your fingers to carry out this operation to avoid the risk of amputation.
- Some phases may require the assistance of more than one operator. If so, it is important to inform and train them regarding the type of activity they will be performing in order to prevent risks to the health and safety of all persons involved.
- Do not use flammable liquids (petrol, diesel, etc.) to degrease or wash components. Use special products.
- Use the oils and greases recommended by the manufacturer.  
Do not mix different brands or combine oils with different characteristics.
- Discontinue use of the engine if any irregularities arise, particularly in the case of unusual vibrations.
- Do not tamper with any devices to alter the level of performance guaranteed by the manufacturer.

## SAFETY AND ENVIRONMENTAL IMPACT

Every organisation has a duty to implement procedures to identify, assess and monitor the influence of its own activities (products, services, etc.) on the environment.

Procedures for identifying the extent of the impact on the environment must consider the following factors:

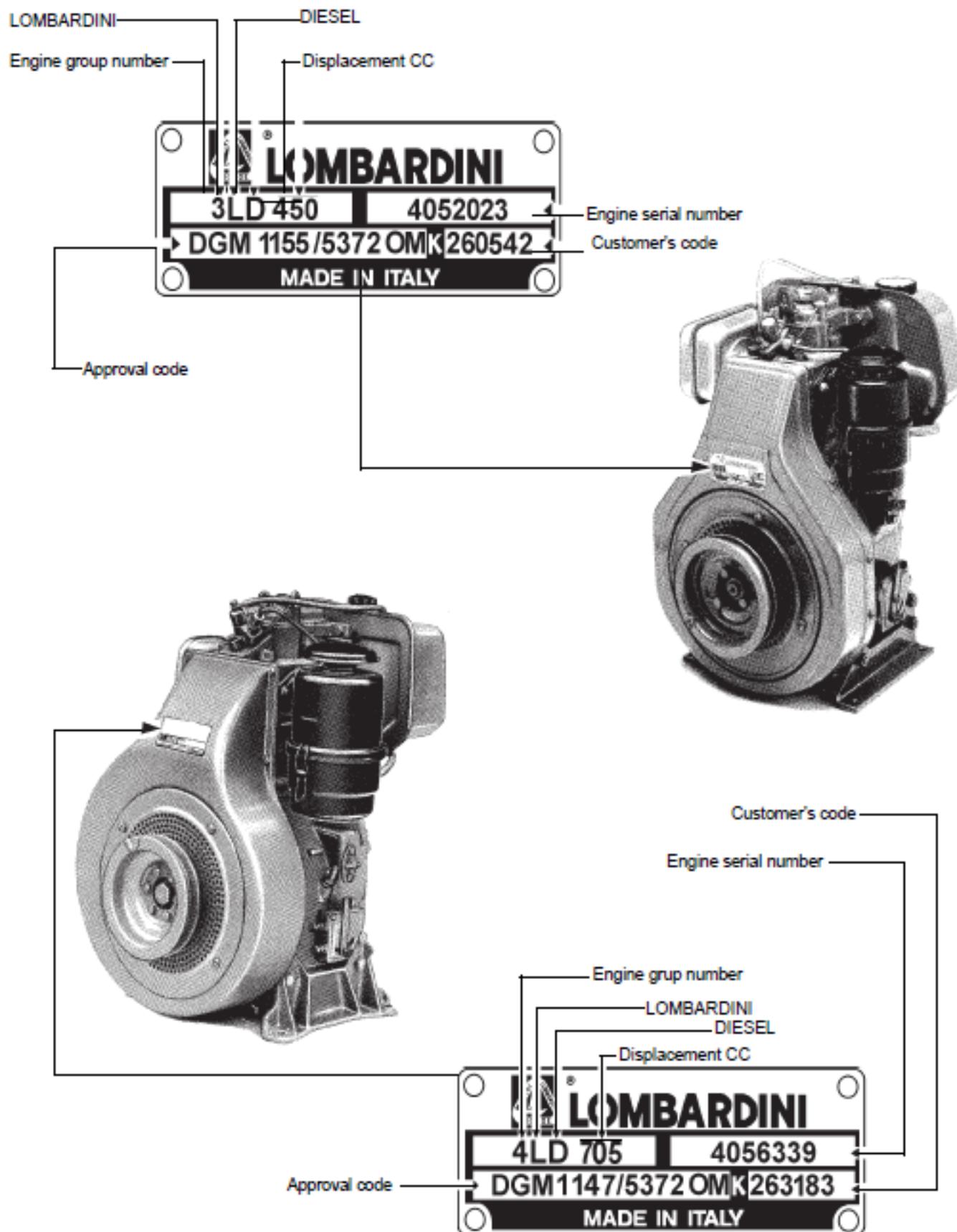
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| <ul style="list-style-type: none"> <li>- Liquid waste</li> <li>- Waste management</li> <li>- Soil contamination</li> </ul> | <ul style="list-style-type: none"> <li>- Atmospheric emissions</li> <li>- Use of raw materials and natural resources</li> <li>- Regulations and directives regarding environmental impact</li> </ul> |
|--|--|

In order to minimise the impact on the environment, the manufacturer now provides a number of indications to be followed by all persons handling the engine, for any reason, during its expected lifetime.

- All packaging components must be disposed of in accordance with the laws of the country in which disposal is taking place.
- Keep the fuel and engine control systems and the exhaust pipes in efficient working order to limit environmental and noise pollution.
- When discontinuing use of the engine, select all components according to their chemical characteristics and dispose of them separately.



## MANUFACTURER AND MOTOR IDENTIFICATION DATA



ENGINE TYPE		3LD450	3LD510
Cylinders	N.	1	1
Bore	mm	85	85
Stroke	mm	80	90
Displacement	Cm <sup>3</sup>	454	510
Compression ratio		18,1:1	18,1:1
rpm		3000	3000
KW Power	N DIN 70020 - 80/1269/CEE - iso 1585	7,5	9,0
	NB DIN 6271 - ISO 3046 - 1 IFN	6,6	7,3
	NA DIN 6271 - ISO 3046 - 1 ICXN	6,0	6,6
Peak torque *	Nm RPM	28,5 @ 1700	32,8 @ 1800
Fuel specific consumption	l/h	1,7	1,9
Oil consumption	Kg/h	0,007	0,008
Dry weight	Kg.	57	60
Combustion air volume at 3000 rpm	l./1'	560	630
Cooling air volume at 3000 rpm	l./1'	9000	9000
Max. axial load permissible for drive shaft in two directions	Kg.	250	250
Max. inclination	instantaneous	a	35°
	extended to 1 h.	α	30°
	permanent	α	****

ENGINE TYPE		4LD640	4LD705	4LD820
Cylinders	N.	1	1	1
Bore	mm	95	100	102
Stroke	mm	90	90	100
Displacement	Cm <sup>3</sup>	638	707	817
Compression ratio		17,0:1	17,0:1	17,0:1
rpm		3000	3000	3000
KW Power	N DIN 70020 - 80/1269/CEE - iso 1585	10,5	12,0	13
	NB DIN 6271 - ISO 3046 - 1 IFN	8,8	9,9 D	11,4 D
	NA DIN 6271 - ISO 3046 - 1 ICXN	7,9	8,8 D	10,3 D
Peak torque *	Nm RPM	38,7 @ 1700	43,1 @ 2000	48 @ 1600
Fuel specific consumption	l/h	2,4	2,6***	3,0***
Oil consumption	Kg/h	0,024	0,030***	0,035***
Dry weight	Kg.	100	100	105
Combustion air volume at 3000 rpm	l./1'	780	770 D	890 D
Cooling air volume at 3000 rpm	l./1'	12000	10400 D	10400 D
Max. axial load permissible for drive shaft in two directions	Kg.	300	300	300
Max. inclination	instantaneous	a	35°	35°
	extended to 1 h.	α	25°	25°
	permanent	α	****	****

\* It stands for power

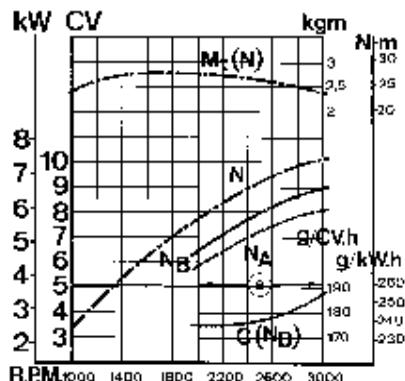
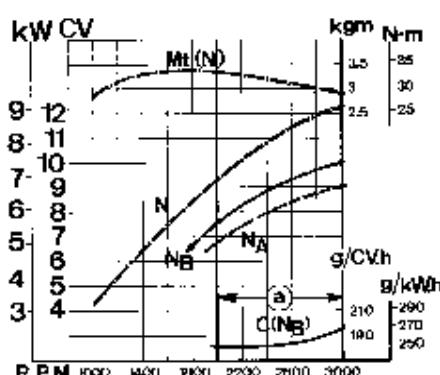
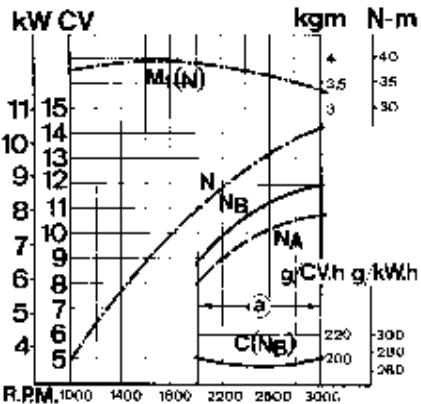
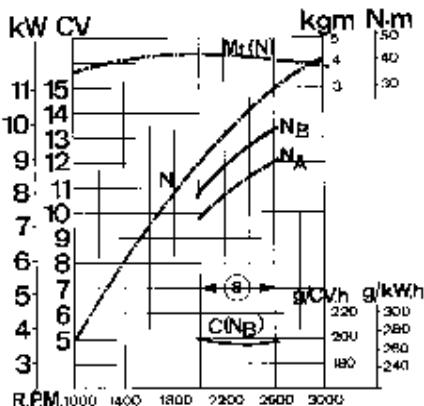
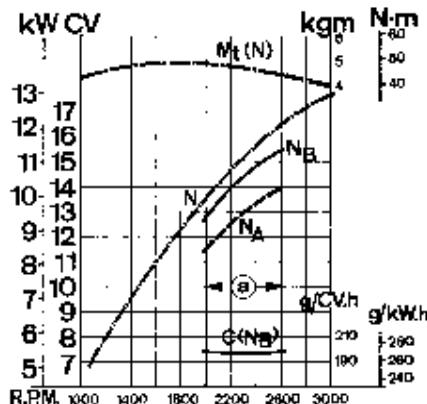
\*\* It stands for NB power

\*\*\* It stands to NB power at 2600 rpm

\*\*\*\* According to the application D at 2600 rpm

**Note:** For LDA 450, LDA 510, LDA 96, LDA 97, LDA 820 out-of-production engines, the repair specifications are equal to those of the engines specified in the table. 3 LD 451/S, 3LD 510/S engines, which are currently produced, not specified in the table, turn anticlockwise (seen from the flywheel side), and are provided with the same feature as 3LD450 and 3LD510engines.

## PERFORMANCE DIAGRAMS

**3LD 450****3LD 510****4LD 640****4LD 705****4LD 820**

**N** (80/1269/EU - ISO 1585)  
**NB** (ISO 3046 - 1 IFN)  
**NA** (ISO 3046 - 1 ICXN)

**AUTOMOTIVES POWER** : Discontinuous services at variable rpm and load.

**NON-OVERLOADABLE POWER**: Continuous light services at constant rpm and variable load.

**CONTINUOUS OVERLOADABLE POWER**: Continuous heavy-duty services at constant rpm and load.

The above mentioned power levels refer to the engine equipped with air filter, standard silencer, suction fan - which previously underwent a breaking-in period - at 20°C ambient conditions, at 1 bar.

The maximum power is guaranteed with a 5% tolerance.

These powers are reduced of abt. 1% every 100 m height and of 2% for every 5°C exceeding 25°C.

**C (NB)**: Specific fuel consumption at NB power

**MT** : Torque at N power

**(a)** : Continuous service field of use. For any purpose out of this field of use, please contact company LOMBARDINI.

## POSSIBLE CAUSES AND TROUBLE SHOOTING

### THE ENGINE MUST BE STOPPED IMMEDIATELY WHEN:

- 1) - The engine rpms suddenly increase and decrease
- 2) - A sudden and unusual noise is heard
- 3) - The colour of the exhaust fumes suddenly darkens
- 4) - The oil pressure indicator light turns on while running.

### **TABLE OF LIKELY ANOMALIES AND THEIR SYMPTOMS**

The following table contains the possible causes of some failures which may occur during operation.  
Always perform these simple checks before removing or replacing any part.

PROBABLE CAUSES		TROUBLE								
		It does not start	It starts but does not stop	It does not accelerate	Inconsistent rpm	Black smoke	White smoke	Low oil pressure	Oil level increase	Excessive oil consumption
FUEL CIRCUIT	Clogged pipings	●								
	Clogged fuel filter	●	●	●						
	Presence of air in the fuel circuit	●	●	●						
	Clogged tank breather	●	●	●						
	Faulty fuel pump	●	●							
	Blocked injector	●								
	Blocked injection pump valve	●								
	Wrong injector setting					●				
	Plunger excessive leakage								●	
LUBRICATION	Stuck injection pump delivery control	●		●	●					
	Wrong injection pump delivery setting		●		●					
	High oil level			●		●				
	Blocked pressure relief valve						●			
	Worn oil pump							●		
	Presence of air inside the oil intake pipe							●		
ELECTRICAL EQUIPMENT	Faulty pressure gauge or switch							●		
	Clogged oil intake duct							●		
	Discharged battery	●								
	Inefficient or wrong cable connection	●								
MAINTENANCE	Faulty starting switch	●								
	Faulty starting motor	●								
	Clogged air filter	●		●		●				
	Excessive idle operation	●					●			●
SETTINGS AND REPAIRINGS	Incomplete running-in						●			
	Overloaded engine		●		●	●	●			
	Advanced injection	●								
	Delayed injection					●				
	Incorrect governor linkage adjustment	●			●					
	Broken or loose governor spring									
	Low idling setting	●		●		●				
	Worn or stuck piston rings						●		●	●
	Worn or scored cylinders						●		●	●
	Worn valve guides						●		●	●
	Sticking valves	●								
	Worn crankshaft-connecting rod bearings							●		
	Non-sliding speed governor leverage	●	●		●					
	Crank shaft not turning freely					●				
	Cylinder head gasket	●								

**ROUTINE ENGINE MAINTENANCE**

**!** Failure to carry out the operations described in the table may lead to technical damage to the machine and/or system

## MAINTENANCE ENGINES 3LD 450 - 510 - 450/S - 510/S 4LD 640 - 705 - 820

OPERATION	DETAIL	INTERVALS (HOURS)							
		10	50	125	250	500	1000	2500	5000
CLEANING	AIR FILTER (OIL-BATH) (*)	●							
	HEAD AND CYLINDER FINS (*)				●				
	FUEL TANK						●		
	INJECTORS				●				
CHECK	LEVEL	●							
	AIR FILTER OIL		●						
	SUMP OIL	●							
	BATTERY LIQUID		●						
	FUEL HOSE COUPLING FASTENING				●				
	VALVE AND ROCKER ARM CLEARANCE					●			
CHANGE	INJECTOR SETTING					●			
	AIR FILTER(**) (***)	●							
	SUMP (***)		□		●				
	OIL FILTER CARTRIDGE		□		●				
OVERHAUL	FUEL FILTER CARTRIDGE			●					
	PARTIAL (****)						●		
	GENERAL							●	

First replacement.

(\*) In particular running conditions even every day.

(\*\*) In particularly dusty environments every 4-5 hours.

(\*\*\*) See prescribed oil.

(\*\*\*\*) It includes the check of cylinders, segments, guides, valve seat springs and grindings, head and cylinder descaling, injection pump and injector checks.

**CAPACITIES IN LITERS****Standard fuel tank**

3LD450, 3LD510, 3LD450/S, 3LD510/S = 5.3  
4LD 640, 4LD705, 4 LD 820 = 7.2

**Standard oil sump:**

3LD450, 3LD510, 3LD450/S, 3LD510/S = 1.75  
4LD640, 4LD705, 4LD 820 = 2.60

**Air filter oil bowl = 0.3**

For special filters, tanks and oil sumps, please follow LOMBARDINI instructions.

## LUBRICANT

### SAE Classification

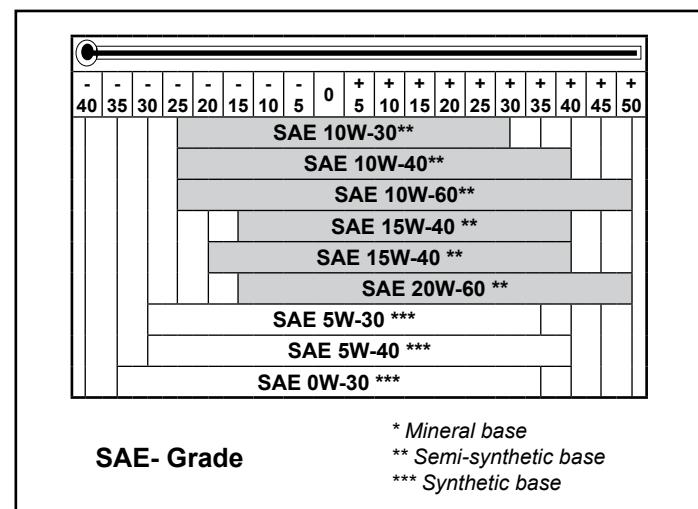
In the SAE classification, oils differ on the basis of their viscosity, and no other qualitative characteristic is taken into account.

The first number refers to the viscosity when the engine is cold (symbol W = winter), while the second considers viscosity with the engine at régime.

The criteria for choosing must consider, during winter, the lowest outside temperature to which the engine will be subject and the highest functioning temperature during summer.

Single-degree oils are normally used when the running temperature varies scarcely.

Multi-degree oil is less sensitive to temperature changes.



### International specifications

They define testing performances and procedures that the lubricants need to successfully respond to in several engine testing and laboratory analysis so as to be considered qualified and in conformity to the regulations set for each lubrication kind.

A.P.I : ( American Petroleum Institute )

MIL : Engine oil U.S. military specifications released for logistic reasons

ACEA : European Automobile Manufacturers Association

Tables shown on this page are of useful reference when buying a kind of oil.

Codes are usually printed-out on the oil container and the understanding of their meaning is useful for comparing different brands and choosing the kind with the right characteristics.

Usually a specification showing a following letter or number is preferable to one with a preceding letter or number.

An SF oil, for instance, is more performing than a SE oil but less performing than a SG one.

### ACEA REGULATIONS - SEQUENCES

LIGHT DUTY DIESEL ENGINES		HEAVY DUTY DIESEL ENGINES	
<b>B1 =</b>	Low-viscosity, for frictions reduction	<b>E2 =</b>	Standard
<b>B2 =</b>	Standard	<b>E3 =</b>	Heavy conditions (Euro 1 - Euro 2 engines )
<b>B3 =</b>	High performances (indirect injection)	<b>E4 =</b>	Heavy conditions (Euro 1 - Euro 2 - Euro 3 engines )
<b>B4 =</b>	High quality (direct injection)	<b>E5 =</b>	High performances in heavy conditions (Euro 1 - Euro 2 - Euro 3 engines )

### API / MIL SEQUENCES

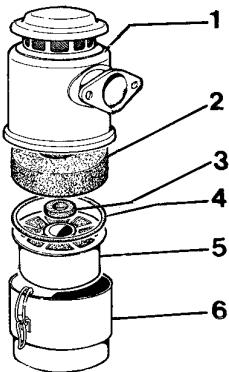
API	CH-4	CG-4	CF-4	CF-2	CF	CE	CD	CC
MIL					L- 46152 D / E			

## RECOMMENDATIONS FOR DISASSEMBLING

**Important**

To locate specific topics, the reader should refer to the index.

- The operator must make sure that the contact surfaces are intact, lubricate the coupling parts and protect those that are prone to oxidation.
- Before any intervention, the operator should lay out all equipment and tools in such a way as to enable him to carry out operations correctly and safely.
- For safety and convenience, you are advised to place the engine on a special rotating stand for engine overhauls.
- Before proceeding with operations, make sure that appropriate safety conditions are in place, in order to safeguard the operator and any persons involved.



1

**Oil-bath air filter (standard)****Danger – Attention**

Always wear protective goggles if compressed air is used.

**Caution – Warning**

Never use solvents with a low flash point to clean the filter element. Such action could cause an explosion.

Oil-bath type with double filtering mass.

The lower mass is made of metal, while the upper is made of polyurethan.

Check the gasket conditions and replace them in case they are damaged.

Make sure that the weldings are not damaged.

Carefully clean the lower body and the filtering masses using some gas oil, blow the lower mass with compressed air and dry the upper mass by means of a cloth. Fill with engine oil filter to the indicated level.

While reassembling, tighten the nuts at 25 Nm (3LD450, 3LD510, 3LD450/S, 3LD 510/S), at 30 Nm (4LD 640, 4LD 705, 4LD 820)

Details:

**1** Upper body

**4** External sealing ring

**2** Filtering mass made  
of polyurethan

**5** Filtering mass

**3** Internal sealing ring

**6** Bowl

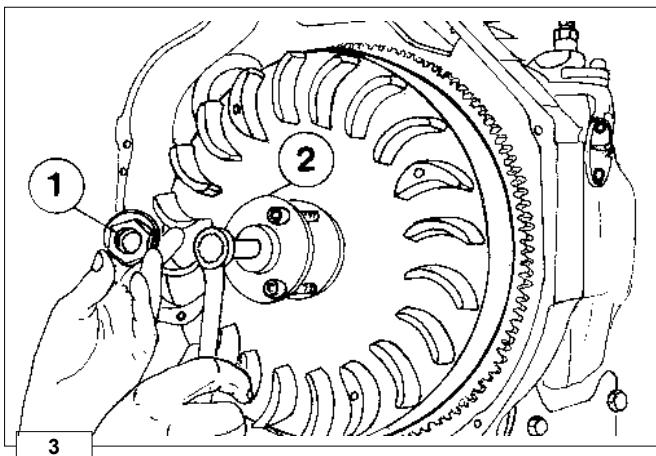


2

**Silencer (standard)****Danger – Attention**

Allow the exhaust manifold to cool before demounting it in order to prevent scorching and burns

Make sure that it is free from any carbon and oily residues, if contaminated, replace it. While reassembling it, replace the gaskets and tighten the brass nuts at 25 Nm.



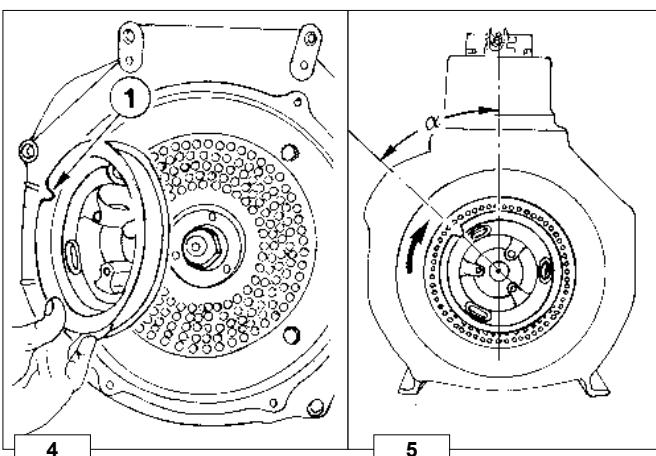
### Flywheel

Clockwise unscrew nut 1 and remove the flywheel using the puller 2 Part. no. 7271-3595-050 for 3LD 450, 3LD 451/S, 3LD510, 3LD510/S, while for 4LD 640, 4 LD 705, 4LD 820 use puller with Part. no. 7271-3595-048.

Check that the starter ring gear, when it is present, and the conic surface of the driving shaft coupling hole are intact.

While reassembling, tighten the screws 1 at 170 Nm for 3LD 450, 3LD 450/S, 3LD510, 3LD 510/S and at 350 Nm for 4LD 640, 4LD 705, 4LD 820.

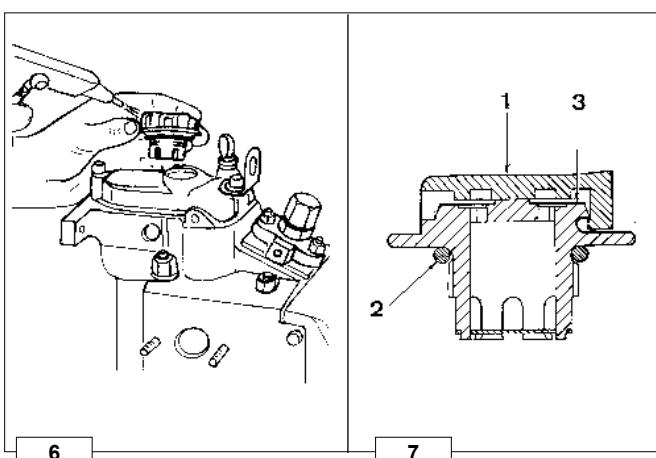
**Note:** The flywheels of the left-hand engines (3LD 451/S, 3LD 510/S) have a blading turned in the opposite direction and the nut 1 shall be anticlockwise unscrewed.



### Starting pulley

In order to carry out any easier starting, it is necessary to place the driving shaft at the TDC (Top dead center) and to assemble the pulley with notch 1 moved back at (45°) according to the rotation direction of the engine, as per picture 4 and 5.

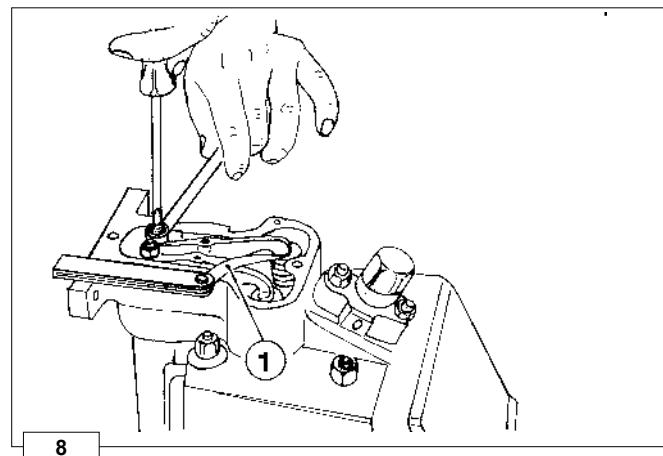
Tighten the screws at 35 Nm for 3LD 450, 3LD 450/S, 3LD510, 3LD 510/S, at 40 Nm for 4LD 640, 4LD 705, 4LD 820.



### Vent plug

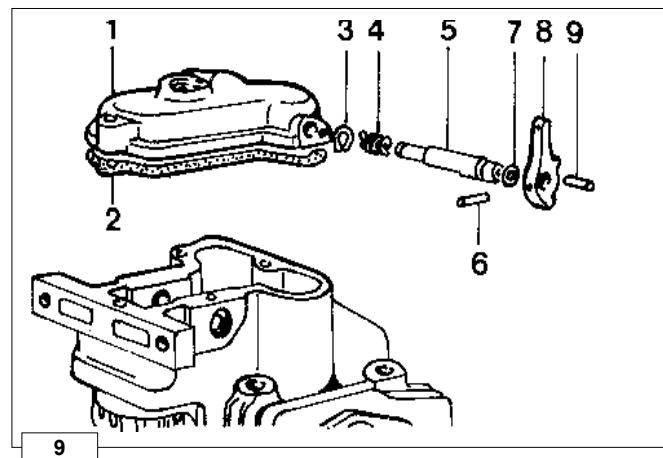
Components:

- 1 Vent plug and oil refiling
- 2 O-ring
- 3 Diaphragm



#### Valve/rocker arm clearance

Place the piston at the compression top dead centre.  
Place thickness gauge 1 between the valve stem and the rocker arm; cold-adjust the clearance at 0.15 ÷ 0.20 mm for both valves.  
Tighten the rocker arm box cap at 20 Nm.



#### Decompression (by request)

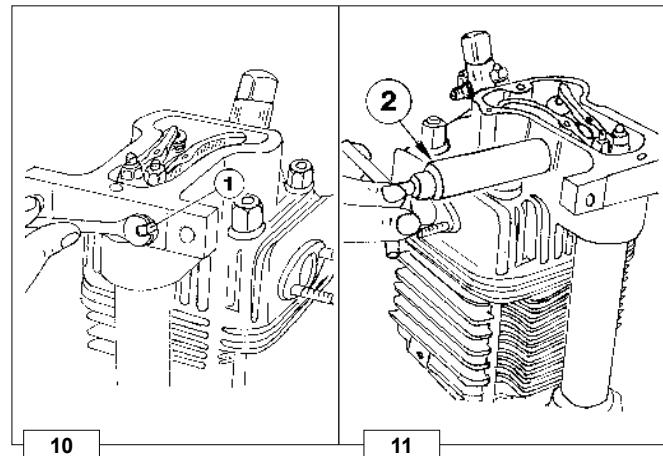
Components:

1 Cover	6 Pin
2 Gasket	7 Ring
3 Lock ring	8 Lever
4 Spring	9 Pin
5 Shaft	

The engine rocker arm cover can be equipped with a decompression device which compresses the exhaust valve at the TDC (top dead centre), lowering it of abt. 1mm. during the starting phase. The lowering is adjusted by the gasket thickness 2. Make sure that the lever turns for abt. half a stroke before it actuates the valve.

Warning!

The use of decompression to stop the engine may cause serious damages.



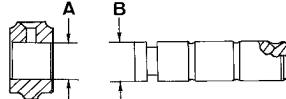
#### Rocker arm pin, extraction

Before extracting the rocker arm pin in 3LD 450, 3LD 451/S, 3LD 510, 3LD510S engines, unscrew screw 1, as per picture 10.

Extract the pin using tool 2 Part. no. 7276-3595-040, picture 11 also for 4LD 640, 4LD 705, 4LD 820 engines.



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### Rocker arm pin and hole

Dimensions (mm)

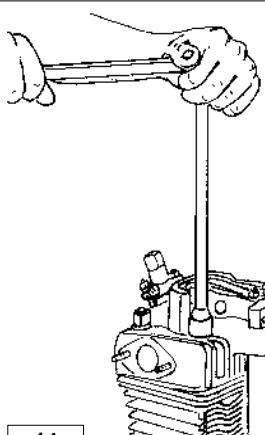
**A** = 15.032 ÷ 15.050

**B** = 14.989 ÷ 15.000

Clearances

(A-B) = 0.032 ÷ 0.061

(A-B) = worn limit = 0.120



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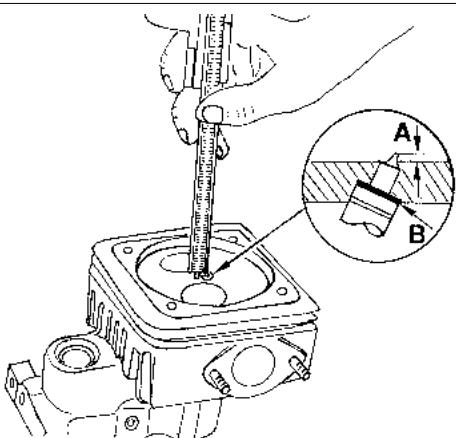
### Head

Do not disassemble while it is hot as to avoid any possible distortion.

If the head surface is distorted, smooth it by removing up to 0.3 mm thickness.

Always replace the copper gasket, see picture 34 for the choice of thickness.

Gradually tighten the nuts according to the following order **1, 3, 2, 4**, at 50 Nm for 3LD 450, 3LD 451/S, 3LD 510, 3LD510/S, and at 80 Nm for 4LD 640, 4LD 705, 4LD 820.



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### Injector, projection

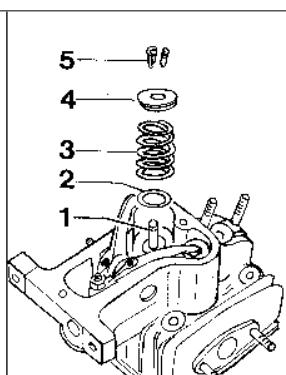
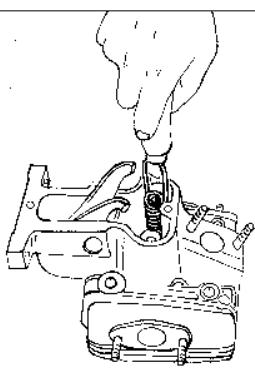
The projection of the nozzle ends **A** with respect to the head surface shall be:

2.5÷3 mm for 3LD 450, 3LD 451/S

3÷3.5 mm for 3LD 510, 3LD 510/S

3.5÷4 mm for 4LD 640, 4LD 705, 4LD 820

Adjust by means of a copper gasket **B** having a thickness of 0.5 mm, 1 mm, 1.5mm .



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### Valves

**1** Valve stem

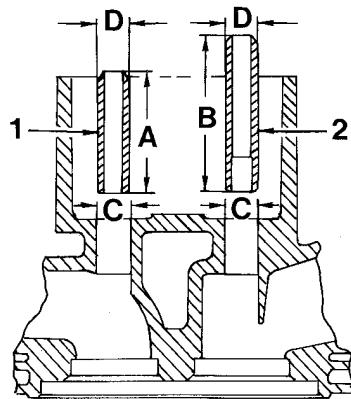
**2** Spring holding disk

**3** Spring

**4** Cap

**5** Cotters

**Note:** In order to remove the cotters, put a shim under the valve head and strongly press, as shown in picture 16.



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**Valves guides and housings****1** Exhaust valve guide**2** Intake valve guide

Dimensions (mm):

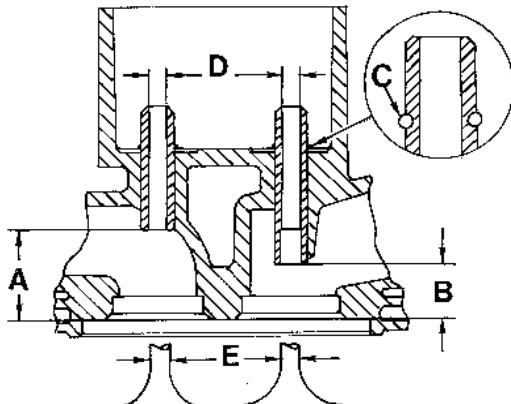
3LD 450, 3LD 451/S, 3LD 510, 3LD 510/S

**A** = 43.80 ÷ 44.20      **B** = 55.80 ÷ 56.20**C** = 11.00 ÷ 11.018      **D** = 11.05 ÷ 11.06

4LD 640, 4LD 705, 4LD 820

**A** = 47.80 ÷ 48.20      **B** = 65.80 ÷ 66.20**C** = 12.000 ÷ 12.018      **D** = 12.05 ÷ 12.06

**Note:** Valve guides with an external dia. increased of 0.5 mm can be used as spare parts; in this case it is necessary to increase the housing **C** of 0.5 mm for the assembly.



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**Valve guides insertion**

Heat the head at 160° ÷ 180°. Force the guides according to **A** and **B** distance with respect to the head surface.

3LD 450, 3LD 451/S, 3LD 510, 3LD 510/S

**A** = 30.80 ÷ 31.2      **B** = 18.8 ÷ 19.2

4LD 640, 4LD 705, 4LD 820

**A** = 35.8 ÷ 36.2      **B** = 17.8 ÷ 18.2

**Note:** if the guides are supplied with the housing for the lock ring **C**, insert the ring, then drive the guides without worrying about **A** and **B**.

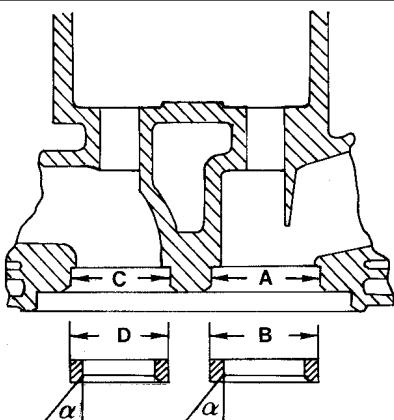
**Valve guide dimensions and clearances**

3LD 450, 3LD 451/S, 3LD 510, 3LD 510/S (mm):

**D** = 7.030 ÷ 7.050    **E** = 6.985 ÷ 7.000**(D-E)** = 0.030 ÷ 0.065    (**D-E**) limit= 0.13

4LD 640, 4LD 705, 4LD 820

**D** = 8.030 ÷ 8.050    **E** = 7.985 ÷ 8.000**(D-E)** = 0.030 ÷ 0.065    (**D-E**) limit = 0.13



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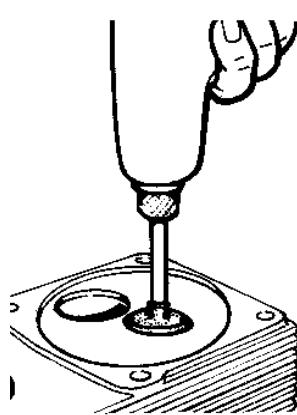
**Valve housings and seats**

3LD 450, 3LD 451/S, 3LD 510, 3LD 510/S (mm):

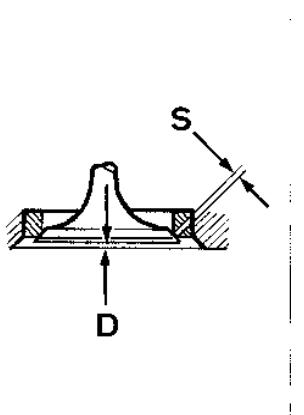
$$\begin{aligned} \mathbf{A} &= 34.99 \div 35.01 & \mathbf{C} &= 30.99 \div 31.01 \\ \mathbf{B} &= 35.10 \div 35.12 & \mathbf{D} &= 31.10 \div 31.12 \end{aligned}$$

4LD 640, 4LD 705, 4LD 820 (mm):

$$\begin{aligned} \mathbf{A} &= 42.99 \div 43.01 & \mathbf{C} &= 36.99 \div 37.01 \\ \mathbf{B} &= 43.12 \div 43.14 & \mathbf{D} &= 37.10 \div 37.12 \end{aligned}$$

 Drive the seats in the housings and mill at  $45^\circ$ .


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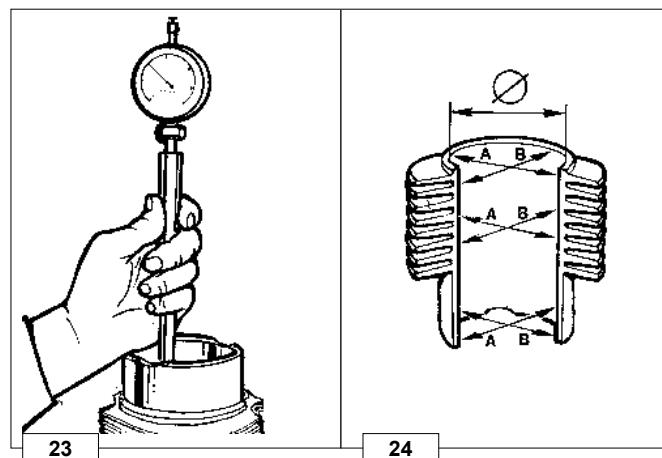


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**Valve seat grinding**

After milling, grind with fine emery paste in engine oil bath.  
The S sealing surface shall not exceed 2 mm.

Embed valves D after grinding for 3LD 450, 3LD 451/S, 3LD 510,  
3LD 510/S =  $0.55 \div 1.05$  mm; for 4LD 640, 4LD 705, 4LD 820 =  
 $0.45 \div 0.95$  mm.



### Cylinder and piston

Set a bore gauge to zero with a calibrated ring. Check the dia.  $\varnothing$  at points **A** and **B** at three different heights, see pictures 23 and 24.

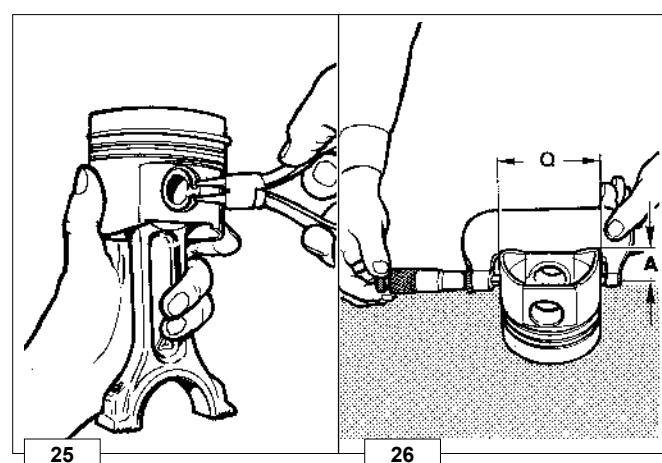
In case of wear exceeding 0.06 mm to the maximum value prescribed, grind the cylinder at the subsequent increased value. The increases suggested are 0.50 and 1.00 mm.

Measure the piston **Q** dia. (picture 26) at **A** height from the skirt base:

$$\mathbf{A} = 17 \text{ mm (3LD 450, 3LD 451/S, 4LD 820)}$$

$$\mathbf{A} = 12 \text{ mm (3LD 510, 3LD 510/S)}$$

$$\mathbf{A} = 22 \text{ mm (4LD 640, 4LD 705)}$$



Remove the stop rings and extract the piston pin, picture 25.

Remove the piston rings and clean the slots.

Replace the piston as well as the segments in case the dia. wear exceeds 0.05 mm as regards to the minimum value prescribed.

### Dimensions (mm)

ENGINES	$\varnothing$	<b>Q</b>	( $\varnothing$ - <b>Q</b> )
3LD 450, 3LD 451/S	85,00 $\div$ 85,02	84,925 $\div$ 84,945	0,05 $\div$ 0,09
3LD 510, 3LD 510/S			
4LD 640	95,00 $\div$ 95,02	94,88 $\div$ 94,90	0,10 $\div$ 0,14
4LD 705	100,00 $\div$ 100,02	99,83 $\div$ 99,85	0,15 $\div$ 0,19
4LD 820	102,00 $\div$ 102,02	101,85 $\div$ 101,89	0,11 $\div$ 0,17

**Note:** Even if 3LD 450, 3LD 450/S and 3LD510, 3LD510/S pistons have the same bore, they differ in other dimensions, thus they are not interchangeable.



### Distance among segment ends (mm)

Insert the piston ring in the lower part of the cylinder, then measure the distance among the points.

3LD 450, 3LD 451/S, 3LD510, 3LD 510/S

$$1^{\text{st}} \text{ piston ring (chromium plated)} \quad \mathbf{A} = 0.30 \div 0.50$$

$$2^{\text{nd}} \text{ piston ring (torsional)} \quad \mathbf{A} = 0.30 \div 0.50$$

$$3^{\text{rd}} \text{ piston ring (scraper ring)} \quad \mathbf{A} = 0.25 \div 0.50$$

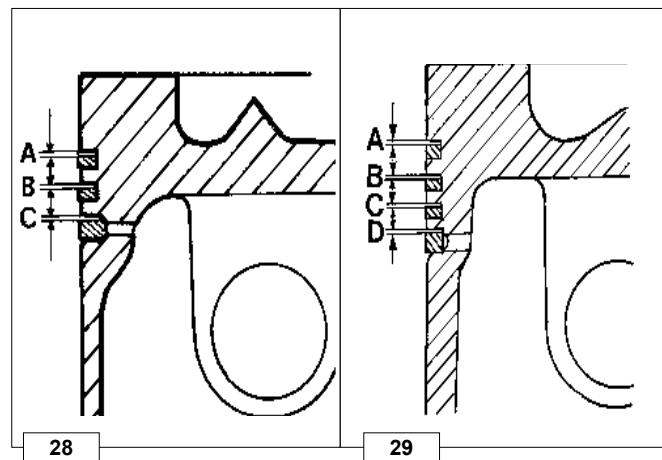
4LD 640, 4LD 705, 4LD 820

$$1^{\text{st}} \text{ piston ring (chromium plated)} \quad \mathbf{A} = 0.40 \div 0.65$$

$$2^{\text{nd}} \text{ piston ring (torsional)} \quad \mathbf{A} = 0.40 \div 0.65$$

$$3^{\text{rd}} \text{ piston ring (torsional)} \quad \mathbf{A} = 0.40 \div 0.65$$

$$4^{\text{th}} \text{ piston ring (oil scraper ring)} \quad \mathbf{A} = 0.30 \div 0.60$$



### Piston ring - Clearances among slots (mm)

3LD 450, 3LD 451/S, 3LD 510, 3LD 510S, picture28

$$\mathbf{A} = 0.08 \div 0.09$$

$$\mathbf{B} = 0.06 \div 0.07$$

$$\mathbf{C} = 0.05 \div 0.06$$

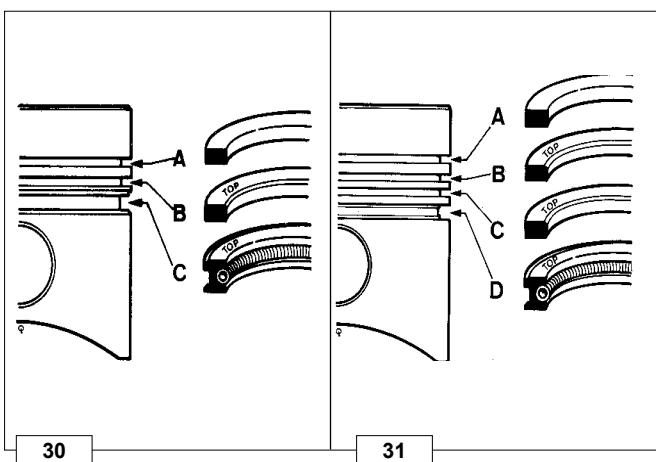
4LD 640, 4LD 705, 4LD 820, picture 29

$$\mathbf{A} = 0.12 \div 0.14$$

$$\mathbf{B} = 0.07 \div 0.09$$

$$\mathbf{C} = 0.07 \div 0.09$$

$$\mathbf{D} = 0.06 \div 0.08$$



#### Piston ring assembly order

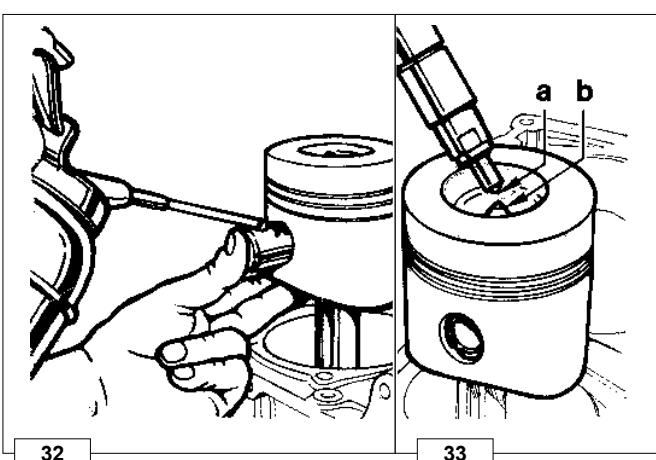
3LD 450, 3LD 450/S, 3LD 510, 3LD 510/S, picture 30

**A** = slot for first piston ring (chromium plated)  
**B** = slot for piston ring segment (torsional)  
**C** = slot for third piston ring (oil scraper ring)

4LD 640, 4LD 705, 4LD 820, picture 31

**A** = slot for first piston ring (chromium plated)  
**B** = slot for second piston ring (torsional)  
**C** = slot for third piston ring (torsional)  
**D** = slot for fourth piston ring (oil scraper ring)

**Note:** before inserting the piston in the cylinder, oil the piston ring with engine oil and turn them, thus the cuts are misaligned.



#### Piston reassembly

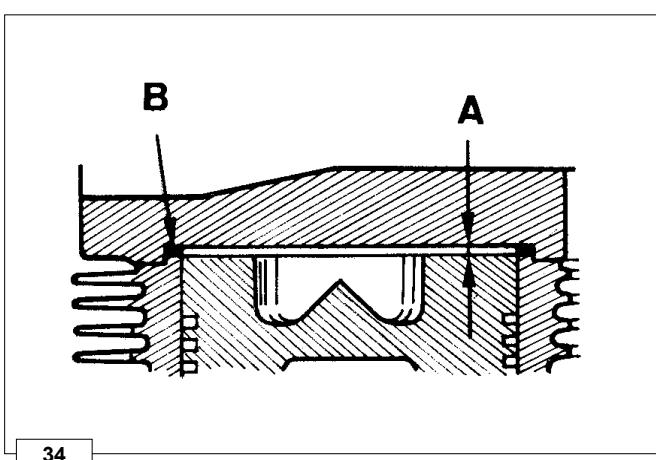
##### Important

Lubricate the following parts with oil before mounting: the piston pin, the piston, the cylinder and the big-end bearing.

Couple the piston with the connecting rod, thus the combustion chamber centre **B** is perpendicularly under end **A** of the nozzle housed inside the head.

Lubricate the piston pin and insert it in the piston, lightly pressing with your thumb.

Make sure that the two stop rings are well housed inside their seats.



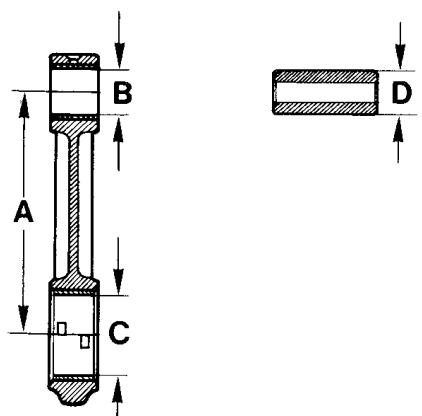
#### Clearance volume

**A** = Clearance volume  
**B** = Head gasket

The thickness **B** head gasket determines the clearance volume **A** which shall be  $0.75 \div 0.90$  mm for 3LD 450, 3LD 451/S, 3LD 510, 3LD 510/S and  $0.80 \div 1.00$  mm for 4LD 640, 4LD 705, 4LD 820.

Measure the piston crown position as to the cylinder surface and chose a gasket having a suitable thickness.

Always consider that the piston at the top dead centre could be at the same level, either under or over the cylinder.



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**Connecting rod equipped with bearings and piston pin**

For 3LD 450, 3LD 450/S, 3LD 510, 3LD 510/S

Dimensions (mm)

**A** = 144.05 ÷ 145.05

**B** = 23.02 ÷ 23.03 (with driven and machined bearing)**C** = 42.028 ÷ 42.052 (with bearing tightening at 3 Nm)

**D** = 22.995 ÷ 23.000

For 4LD 640, 4LD 705, 4LD 820

Dimensions (mm)

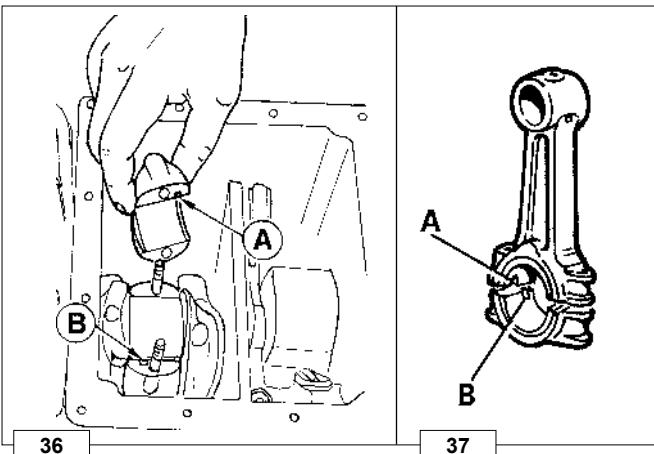
**A** = 162.95 ÷ 163.05

**B** = 28.02 ÷ 28.03

**C** = 55.40 ÷ 55.43

**D** = 27.995 ÷ 28.000

The connecting rod big end bearings are supplied either at nominal value and diminished to 0.25 and 0.50 mm.



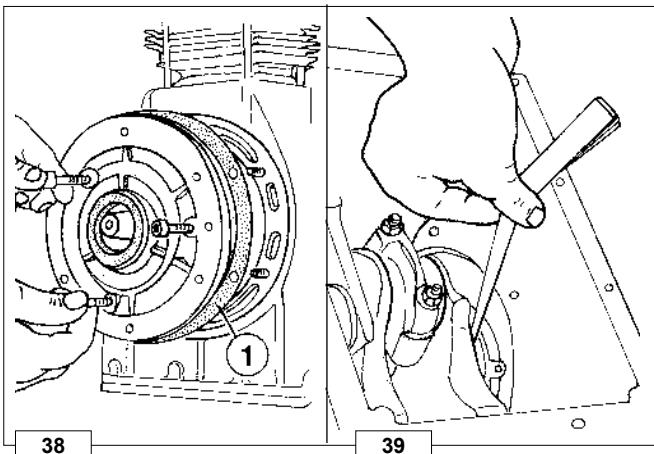
36

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**Connecting rod, big end bearings**

While reassembling, the A and B centering marks should not be on the same side.

Tighten the screws at 30 Nm for 3LD 450, 3LD 451/S, 3LD 510, 3LD 510/S and at 45 Nm for 4LD 640, 4LD 705, 4LD 820.



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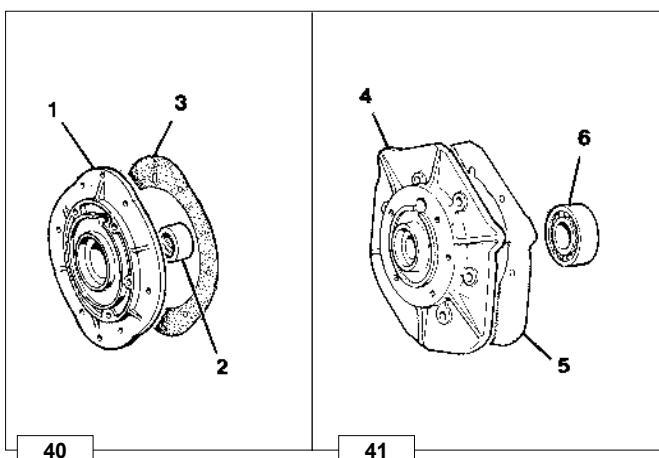
**Main bearing on flywheel side**

Extract the bearing using three screws, as per picture 38. While reassembling, replace gasket 1. Check that the oil seal ring is intact. Tighten the screws at 25 Nm.

**Drive shaft axial clearance**

After having screwed the main bearing on the flywheel, check drive shaft axial clearance. Its value is 0.10 ÷ 0.40 mm for 3LD 450, 3LD 450/S, 3LD 510, 3LD 510/S and 0.10 ÷ 0.30 mm for 4LD 640, 4LD 705, 4LD 820.

The adjustment is carried out by changing the gasket 1 thickness.



### Side distributor port

It can be found in engines equipped with industrial type drive shaft.

The gaskets 3 and 5, thanks to their thickness, assure the oil seal and affect the camshaft axial clearance, as well.

For the check, see information hereunder.

#### Components

For 3LD 450, 3LD 510 picture 40

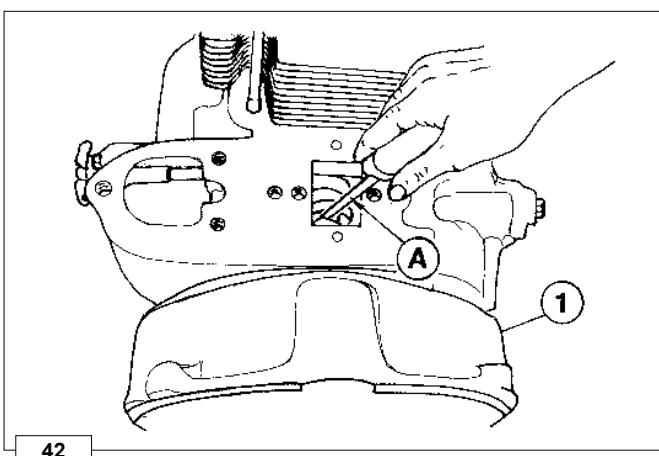
**1** Port      **2** Bush      **3** Gasket

Fix the door at its base at 25 Nm.

For 4LD 640, 4LD 705, 4LD 820 picture 41

**4** Port      **5** Gasket      **6** Ball bearing

Fix the port at its base at 40 Nm.



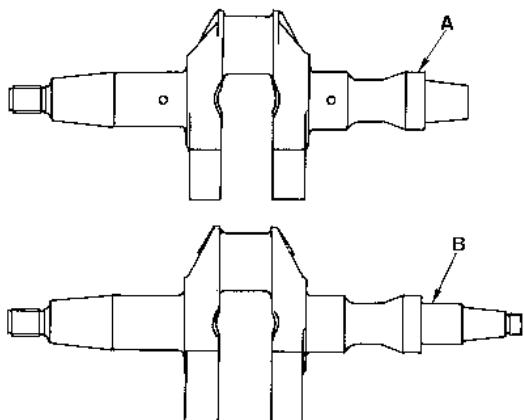
### Camshaft axial clearance

Carry out this check before assembling the head. Fix the side distributor port or bell 1 at 25 Nm. Remove the intake and exhaust tappets and with an implement operate on the camshaft forward and backward in an axial direction.

The axial clearance **A** shall be:

**A** = 0.20 ÷ 0.60 mm 3LD 450, 3LD 450/S, 3LD 510, 3LD 510/S.  
**A** = 0.15 ÷ 0.65 mm for 4LD 640, 4LD 705, 4LD 820.

Adjust the clearance by changing the gasket thickness between the distributor port (if it is assembled) or bell 1 and the base; it is forbidden to assemble more than one gasket.



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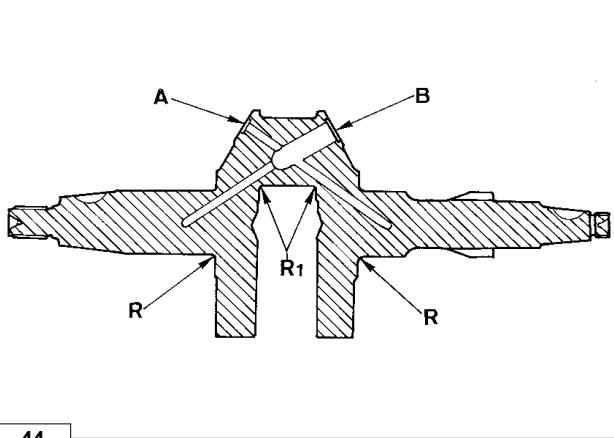
**Drive shaft**

There are two types of standard drive shafts:

**A** Automotive type (agricultural machines)

**B** industrial type (motor pumps generating set, etc.)

**Note:** For left-handed engines, i.e. 3LD 510/S, the drive shaft turns anticlockwise (seen from the flywheel position) and their thread is clockwise on the power takeoff side as well as on the flywheel side.



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**Drive shaft lubrication ducts**

Always wear protective goggles if compressed air is used.

Remove the caps, clean the ducts **A** and **B** with a point and blow them with compressed air.

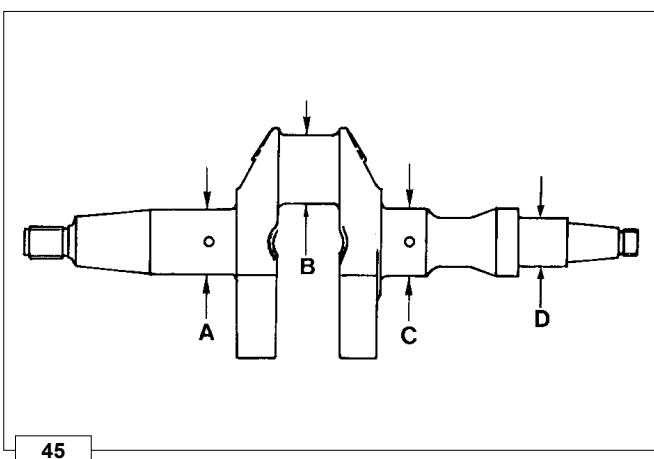
Replace the caps by caulking them on their seat, then check their seal.

**Drive shaft connecting radius**

**R** = 3 mm

**R<sub>1</sub>** = 3.5 mm

**Note:** When the main journal and the crank are ground, it is essential to reset **R** and **R<sub>1</sub>** values in order to avoid any possible breaking of the drive shaft.



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**Drive shaft main journal and crank diametres (mm)**

3LD 450, 3LD 510, 3LD 451/S, 3LD 510/S

**A** = 39.990 ÷ 40.000

**B** = 41.987 ÷ 42.000

**C** = 41.990 ÷ 42.000

**D** = 29.990 ÷ 30.000

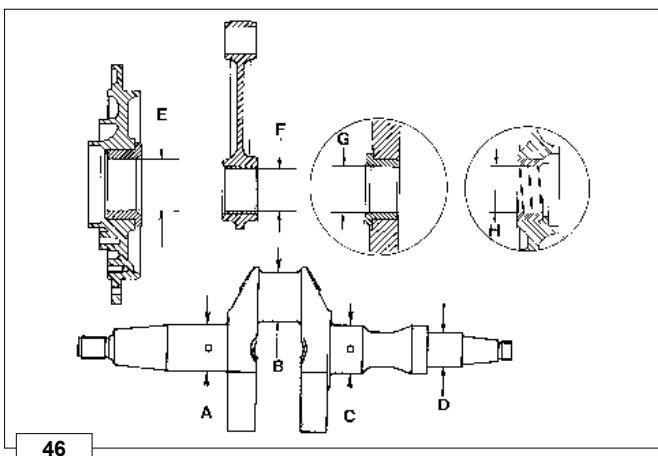
4LD 640, 4LD 705, 4LD 820

**A** = 44.900 ÷ 45.000

**B** = 55.340 ÷ 55.353

**C** = 44.900 ÷ 45.000

**D** = 29.990 ÷ 30.000



**Drive shaft internal diam. crankshaft bearing / connecting rod head and clearances regarding their respective pins (mm)**

3LD 450, 3LD 510, 3LD 451/S, 3LD 510/S

$$\begin{array}{ll} \mathbf{E} = 40.040 \div 40.050 & \mathbf{F} = 42.028 \div 42.052 \\ \mathbf{G} = 42.04 \div 42.05 & \mathbf{H} = 30.07 \div 30.09 \end{array}$$

A, B, C, D, see picture 45

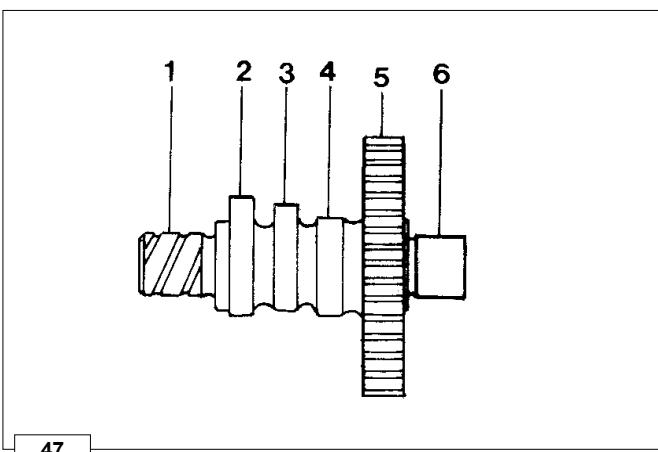
$$\begin{array}{ll} \mathbf{E - A} = 0.040 \div 0.060 & \text{worn limit 0.12} \\ \mathbf{F - B} = 0.028 \div 0.065 & \text{worn limit 0.13} \\ \mathbf{G - C} = 0.040 \div 0.060 & \text{worn limit 0.12} \\ \mathbf{H - D} = 0.070 \div 0.10 & \text{worn limit 0.18} \end{array}$$

4LD 640, 4LD 705, 4LD 820

$$\mathbf{E} = 45.045 \div 45.070 \quad \mathbf{F} = 55.40 \div 55.43 \quad \mathbf{G} = 45.045 \div 45.070$$

A, B, C, D, see picture 45

$$\begin{array}{ll} \mathbf{E - A} = 0.065 \div 0.080 & \text{worn limit 0.16} \\ \mathbf{F - B} = 0.051 \div 0.10 & \text{worn limit 0.18} \\ \mathbf{G - C} = 0.45 \div 0.080 & \text{worn limit 0.16} \end{array}$$

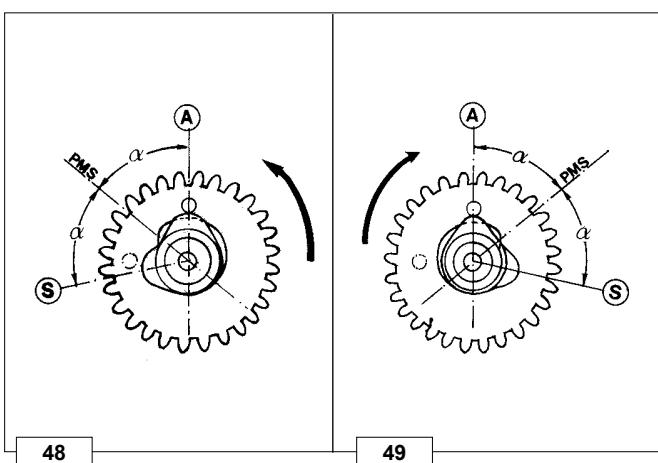


## CAMSHAFT

Components:

- 1 Base side pin
- 2 Intake cam
- 3 Injection cam
- 4 Exhaust cam
- 5 Gear
- 6 Side distributor port pin

**Note:** The two engine series 3LD 450, 3LD 510 and 4LD 640, 4LD 820 have the same camshaft; it differs in 3LD 451/S and 3LD 510/S left-handed engines.



## Camshaft intake and exhaust cam timing

For 3LD 450, 3LD 510, 4LD 640, 4LD 705, 4LD 820, see picture 48.  
Clockwise rotation.

TDC = Top dead centre of the piston

A = Intake cam axis

S = Exhaust cam axis

$\alpha = 50^\circ 30' \div 51^\circ 30'$

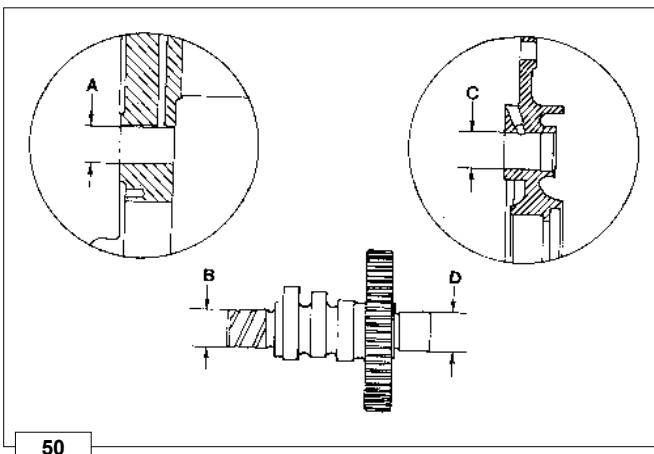
For 3ld 451/S, 3LD 510/S, see picture 49  
Clockwise rotation

TDC= Top dead centre of the piston

A = Intake cam axis

S = Exhaust cam axis

$\alpha = 50^\circ 30' \div 51^\circ 30'$


**Camshaft pin and housing dimensions (mm)**

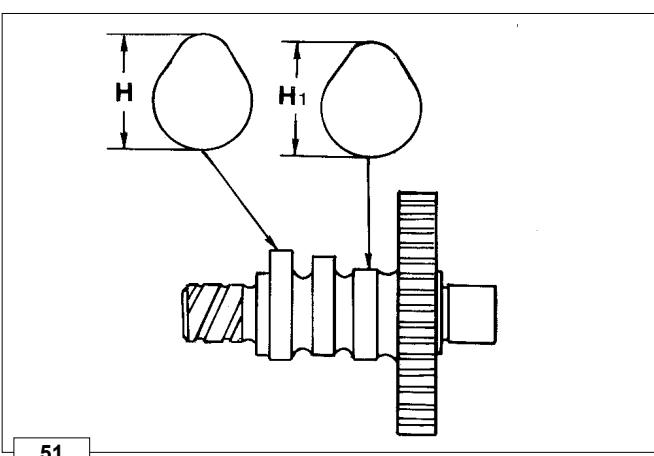
**A** = 18.000 ÷ 18.018 (housing on the base)

**B** = 17.945 ÷ 17.975

**C** = 18.000 ÷ 18.018 (housing on the port)

**D** = 17.945 ÷ 17.975

**A-B** and **C-D** = 0.025 ÷ 0.073      Worn limit = 0.13


**Camshaft intake and exhaust cam height.**

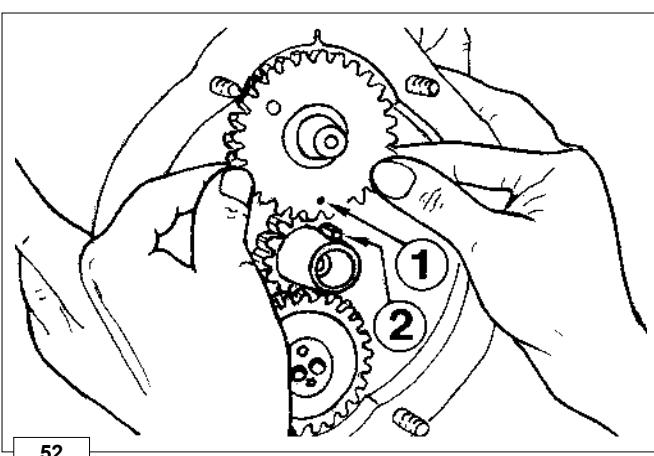
The two cam heights are different.

Dimensions (mm) :

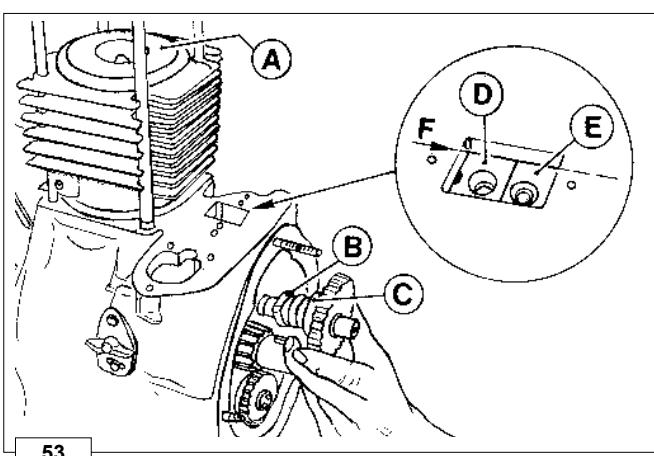
**H** = 33.92 ÷ 34.02 (intake cam)

**H1** = 33.42 ÷ 33.52 (exhaust cam)

If the cam wear exceeds the agreed minimum value of 0.1 mm for **H** and **H1**, replace the camshaft.


**Distribution timing**

assemble the camshaft gear by coinciding reference 1 with reference 2 of the gear (camshaft key).

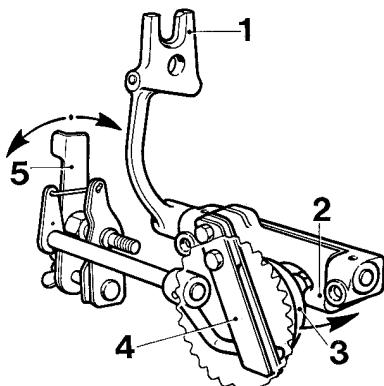

**Distribution timing without following the references**

Place piston **A** at the top dead centre.

Insert the camshaft, thus the intake cam **B** and the exhaust cam **C** are well balanced (while the intake opens, the exhaust closes).

Insert the respective tappets **D** and **E**.

Carry out the check: the intake **D** and exhaust **E** tappets laid on their cams shall be at the same level **F**.

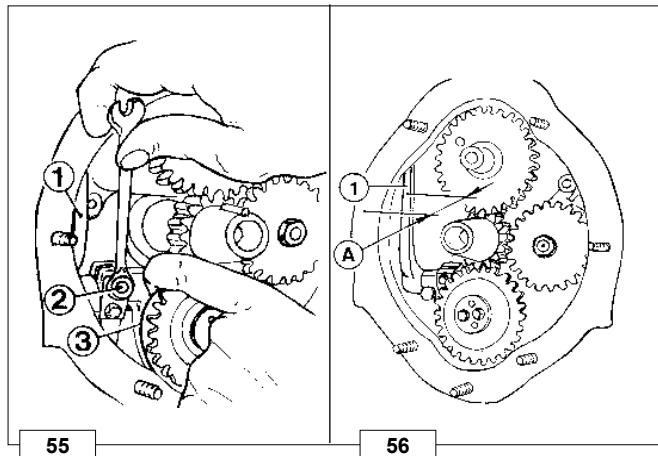


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### Speed governor

It has a centrifugal system with 6 balls housed in the gear, which is directly operated by the drive shaft.

The balls, moved at the gear periphery by a centrifugal force, axially shift the bell 3, which actuates the fork 2 connected to lever 1 in order to determine the injection pump rack rod position. A spring with two plates 4, energized by the accelerator control 5, opposes the action of the governor centrifugal force. The balance between the two forces keeps the rpm rate constant with the change of load.



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### Timing of the speed governor

Adjust the injection pump control lever 1 thus, when the governor is closed, it is placed at distance A as to the external surface of the base.

- Loosen the screw 2.
- Close the governor (move the mobile bell 3 towards the operator, picture 55).
- Place lever 1 at A distance, picture 56 (22 mm for 3LD 450, 3LD 510, 3LD 451/S, 3LD 510/S and 28 mm for 4LD 640, 4LD 705, 4LD 820).
- Tighten the screw 2.

**Danger – Attention**

The engine can be damaged if allowed to operate with insufficient oil. It is also dangerous to add too much oil because its combustion may lead to a sharp increase in the rotation speed.

Use suitable oil in order to protect the engine.

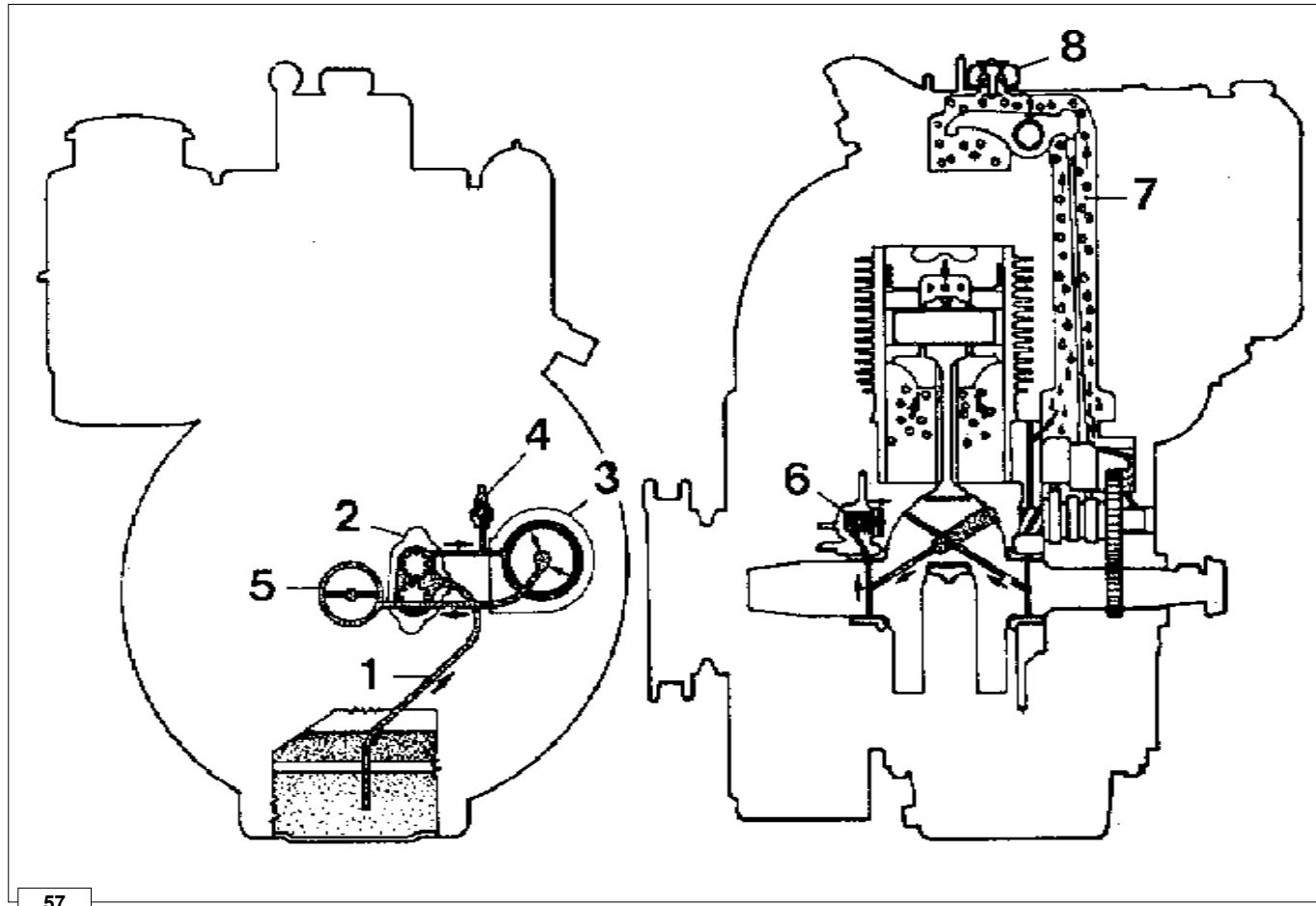
Nothing more than lubrication oil can influence the performances and life of an engine.

Use of an inferior quality oil or failure to regularly change the oil will increase the risk of piston seizure, will cause the piston rings to jam and will lead to rapid wear on the cylinder liner, the bearings and all other moving parts. Engine life will also be notably reduced. The oil viscosity must suit the ambient temperature in which the engine operates.

Old engine oil can cause skin cancer if repeatedly left in contact with the skin and for long periods of time. If contact with the oil is unavoidable, you are advised to wash your hands with soap and water as soon as possible.

Dispose of old oil in the correct way as it is highly polluting.

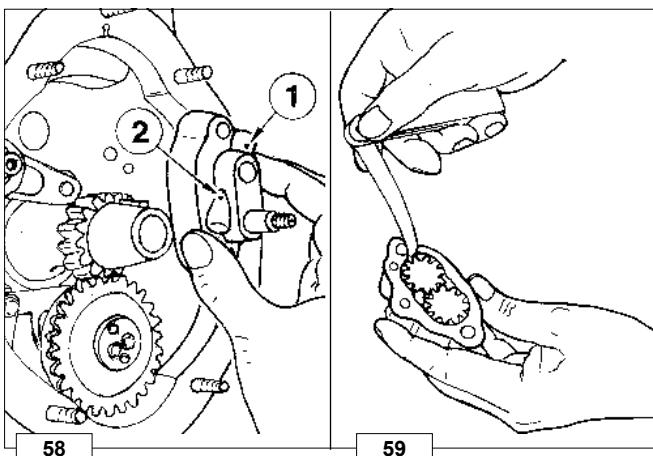
## LUBRICATION CIRCUIT



### Lubrication circuit

Details:

- |                   |                              |
|-------------------|------------------------------|
| 1 Intake pipe     | 5 Crankshaft bearing         |
| 2 Oil pump        | 6 Pressure adjusting valve   |
| 3 Oil filter      | 7 Tappet rod protection pipe |
| 4 Pressure switch | 8 Vent and oil filler plug.  |



### **Oil pump**

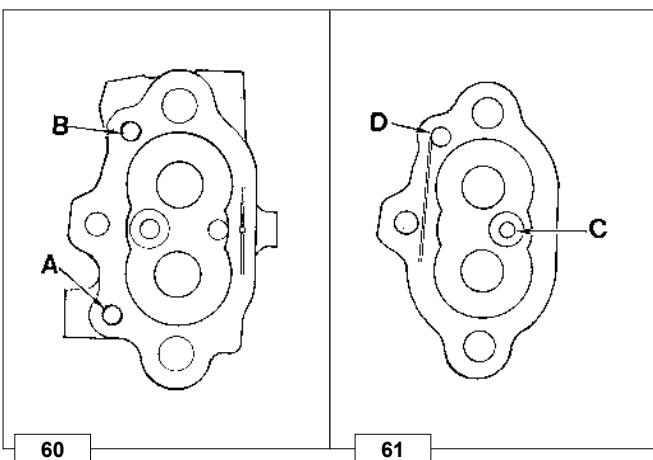
Make sure that the gear teeth are intact and check that the clearance between the gear periphery and the pump case does not exceed 0.15 mm and that the drive shaft can easily turn with an axial clearance not exceeding 0.15 mm.

Check that the gear lubrication holes 1 and 2 are not clogged.

Tighten the pump case at 30 Nm.

Tighten the pump control gear at 20 Nm.

The oil pumps for 3LD 451/S and 3LD 510/S engines, which turn anticlockwise (from flywheel position), are different, see information below.



### **Oil pump, difference between clockwise rotation pump and anticlockwise pump**

The difference between the oil pump on clockwise rotation engines and the anticlockwise one is the suction duct provided either with the pump case and with the base.

See picture 60 for anticlockwise rotation engines from flywheel position (3LD 451/S, 3LD 510/S).

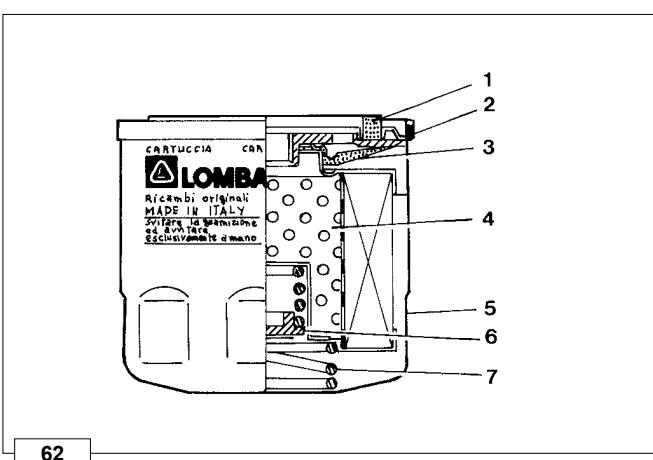
**A** = Intake

**B** = Delivery

Picture 61, for clockwise rotation engines, seen from the flywheel side (3LD 450, 3LD 510, 4LD 640, 4LD 705, 4LD 820)

**C** = Intake

**D** = Delivery



### **Oil filter cartridge**

Components:

- |                           |                 |
|---------------------------|-----------------|
| 1 Gasket                  | 5 Bowl          |
| 2 Assembly                | 6 By-pass valve |
| 3 Antidrainage rubber cap | 7 Spring        |
| 4 Filter element          |                 |

### **Features:**

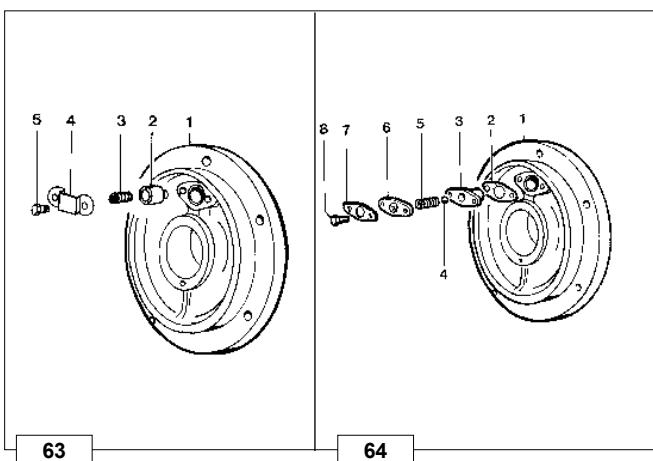
Maximum operating pressure: 7 bars

Maximum operating temperature: -25° + 150°C

Filtering degree: 20 µm

By-pass valve setting: 1÷ 1.4

Total filtering surface: 750 cm<sup>2</sup>



### **Oil pressure regulating valve**

It is housed in the flywheel side main bearing

For 3LD 450, 3LD 451/S, 3LD 510, 3LD 510/S, see picture 63

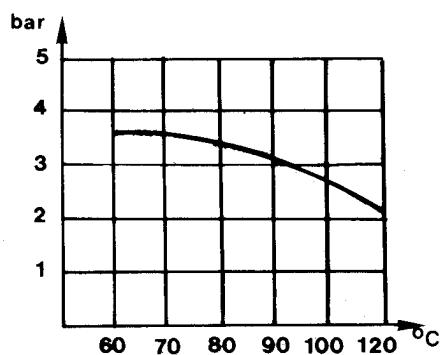
- |           |               |
|-----------|---------------|
| 1 Support | 4 Sheet metal |
| 2 Valve   | 5 Screw       |
| 3 Spring  |               |

Tighten the support at 25 Nm.

For 4LD 640, 4LD 705, 4LD 820, see picture 64

- |                 |          |
|-----------------|----------|
| 1 Support       | 5 Spring |
| 2 Gasket        | 6 Flange |
| 3 Valve support | 7 Plate  |
| 4 Ball          | 8 Screw  |

Tighten the support at 40 Nm.



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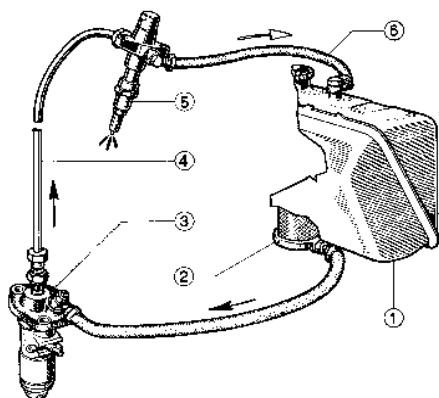
### Oil pressure check

After the assembly operation, fill the engine with oil and fuel; connect a 10 bars pressure gauge to the fitting on the oil filter. Start the engine and check the pressure reaction according to oil temperature.

### Oil pressure curve with the engine at its maximum speed

It is shown on the filter and obtained with the engine at 3000 rpm at **N** power; the pressure is expressed in bars and the temperature in degrees Celsius. The curve represents the pressure minimum value, while its maximum value is 5 bars. The minimum oil pressure (1200 rpm) with the oil temperature at 100° C shall not be lower than 0.8 bars.

**Note:** When the engine has been run in, the oil lubrication maximum temperature shall be lower than the following addition: ambient temperature + 95° C.

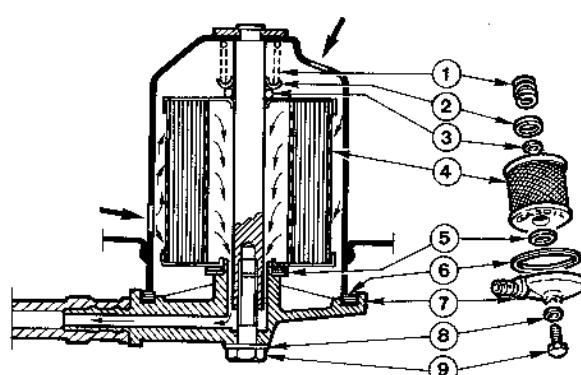


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**Standard feeding/injection circuit**

Components:

- 1** Tank
- 2** Filter
- 3** Pump
- 4** Pipe
- 5** Injector
- 6** Injector waste pipe



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**Fuel filter inside the tank (standard)**

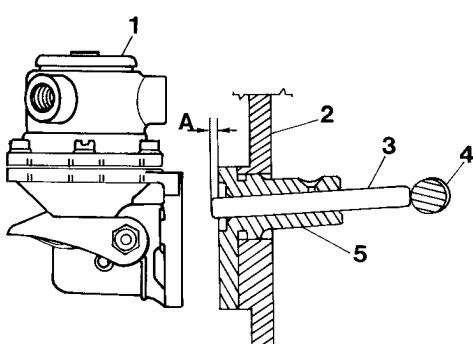
Details:

- |                    |                 |
|--------------------|-----------------|
| <b>1</b> Spring    | <b>6</b> Gasket |
| <b>2</b> Disk      | <b>7</b> Cover  |
| <b>3</b> Ring      | <b>8</b> Ring   |
| <b>4</b> Cartridge | <b>9</b> Bolt   |
| <b>5</b> Gasket    |                 |

Cartridge features:

Filtering degree = 7 µm

Filtering surface = 390 cm<sup>2</sup>



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**Feeding pump (by request)**
**Features:**

at 1500 rpm of the control eccentric, the minimum delivery is 60 l/h, while the automatic adjustment pressure is 4 ÷ 5 m column of water.

**Feeding pump rod projection**

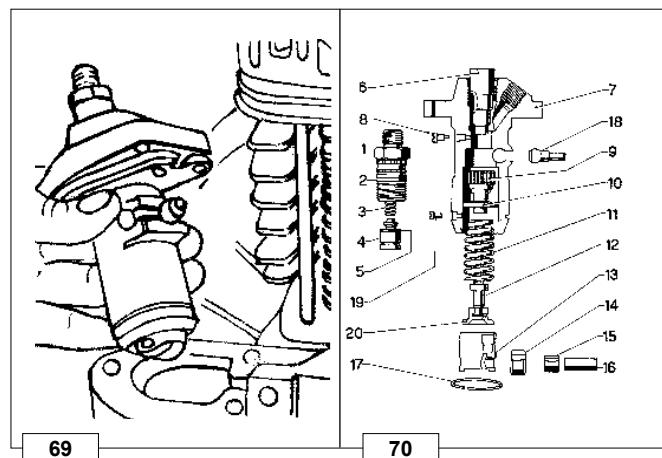
Details:

- 1** Feeding pump
- 2** Base
- 3** Rod
- 4** Oil pump drive shaft eccentric

The check shall be carried out with the eccentric **4** at rest.

The projection A of rod 3 is 0.8 ÷ 1.2 mm; it shall be adjusted with the following supplied gaskets having a thickness of 0.50; 0.80 and 1.0 mm.

Rod length = 65.4 mm for 3LD 450, 3LD 450/S, 3LD 510, 3LD 510/S and 75.2 mm for 4LD 640, 4LD 705, 4LD 820.



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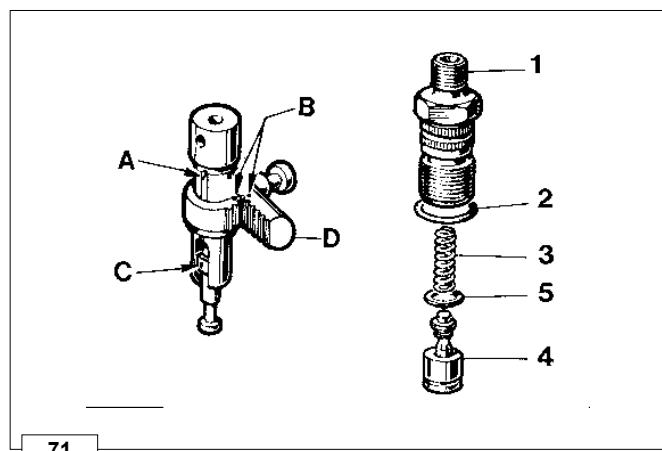
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### Injection pump

#### Components:

- |                       |                    |
|-----------------------|--------------------|
| 1 Delivery fitting    | 11 Spring          |
| 2 O-ring              | 12 Pumping piston  |
| 3 Spring              | 13 Tappet case     |
| 4 Delivery valve      | 14 External roller |
| 5 Gasket              | 15 Internal roller |
| 6 Barrel              | 16 Pin             |
| 7 Pump case           | 17 Lock ring       |
| 8 Eccentric           | 18 Rack rod        |
| 9 Sector gear         | 19 Lock pin        |
| 10 Spring bearing cap | 20 Collar          |

Tighten the pump at its base at 30 Nm.



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### Injection pump assembly

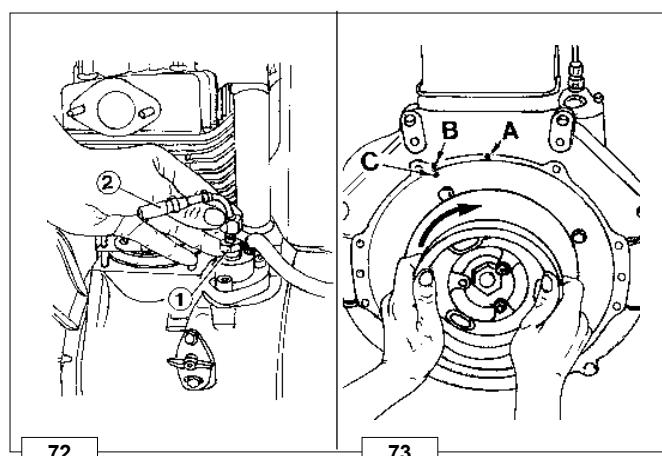
Insert the cylinder **6** in the pump case **7**, engaging the slot **A** in the eccentric **8**.

Insert the delivery valve **4**, copper gasket **5**, spring **3** O ring **2**, then tighten the fitting at 3.5 ÷ 40 Nm.

Assemble the rack rod **18** and sector gear **9** coinciding points **B**. Insert the upper collar **10**, spring **11** and piston **12** with reference **C** on the same side of the slot **A** (if it is assembled on the opposite side, the engine revs out).

Assemble the collar **20**, the tappet **13** with rollers **14**, **15** and pin **16**.

While pressing on the tappet, insert the pin **19** and the ring **17**.



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### Advanced injection (static)

Disconnect the diesel oil thrust pipe fitting, being careful not to loosen also the pump delivery fitting **1**, then screw the tester for the advanced injection check **2**.

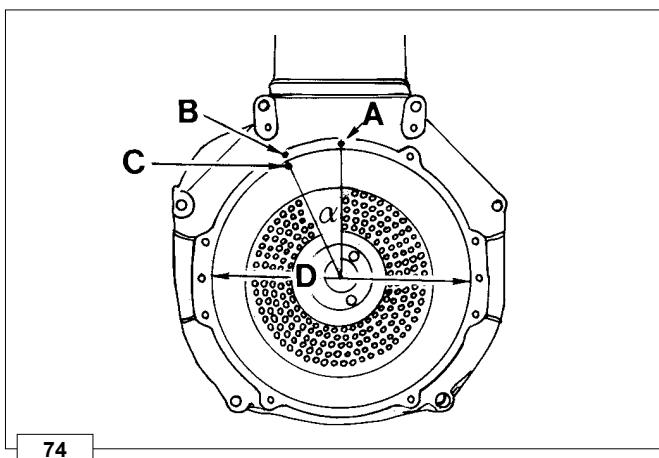
Fill the tank, checking that the fuel level is at least 10 cm above the tester. Place the accelerator lever halfway.

Turn the flywheel towards the engine rotation direction and make sure that the fuel arrives at the tester assembled on the injection pump delivery fitting.

Repeat this operation; during the compression phase, operate slowly and immediately stop when the fuel moves into the tester hole; move the flywheel 3 mm back; this is the static advanced injection.

If **C** does not coincide with **B** but comes before, add some shims under the pump, otherwise, remove the shims if **C** is beyond **B**.

**Note:** By removing or adding a 0.1 mm shim under the pump, it is possible to delay or advance **C**, which is after **B**.



### Advanced Injection references on the conveyor and flywheel protection disk

A Piston reference at top dead centre

B Injection advance reference as to A

A + B Distance in mm

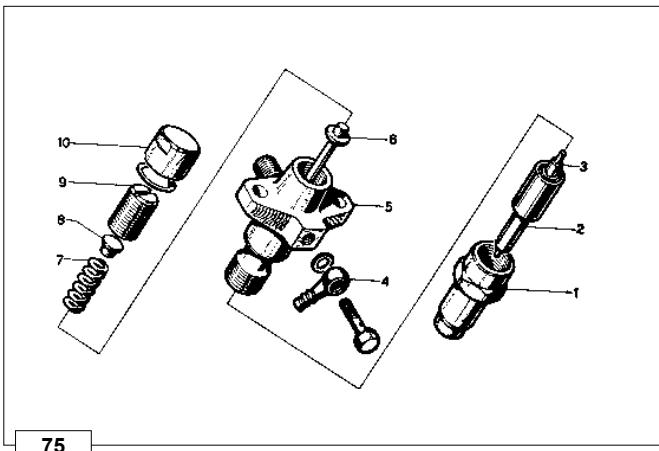
C Reference of piston in injection advance position

$\alpha$  Reference in degrees

D Flywheel protection disk diameter

ENGINES	(A-B) mm	$\alpha$ mm	D (3LD) mm	D (4LD) mm
3LD 450, 451/S, 510, 510/S	58 ÷ 63	24° ÷ 26°	276	310
4LD 640, 705, 820	65 ÷ 70			
4LD 820 a 2600 giri/1'	60 ÷ 65	22° ÷ 24°		

Note: 1° stands for 2.7 mm on dia. D = 310 mm; on dia. D = 276 mm, 1° stands for 2.4 mm.



### Injector

#### Components:

1 Ring nut

2 Nozzle

3 Needle

4 Fitting

5 Nozzle bearing

6 Pressure rod

7 Spring

8 Spring seat

9 Union

10 Ring nut

#### Setting

Connect the injector to a manual pump and check that the setting pressure is 190 ÷ 200 bars.

If necessary adjust, actuating the union 9.

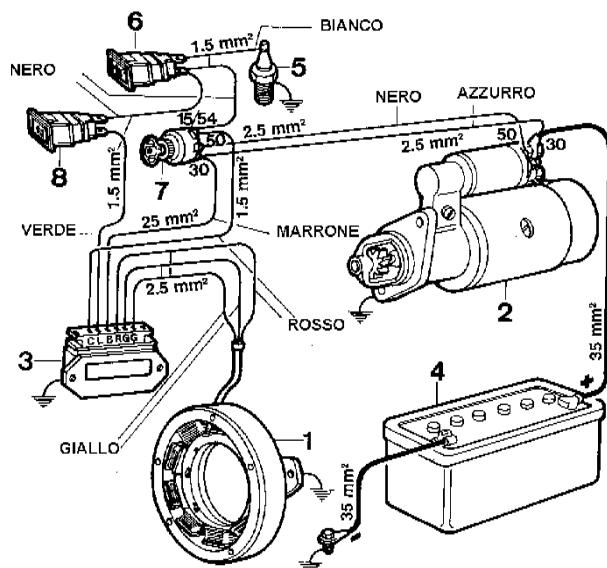
While replacing the spring, the setting shall be carried out at a pressure higher than 10 bars (200 ÷ 210 bars) in order to counterbalance the running adjustments.

Check the needle valve seal by slowly activating the manual pump up to abt. 170 bars.

In case of dripping, replace the nozzle.

Tighten the injector to the head at 15 Nm for 3LD 450, 3LD 451/S, 3 LD 510, 3 LD 510/S and at 20 Nm for 4LD 640, 4LD705, 4LD 820.

**Note:** A new injector is currently assembled, its components are different, though the setting remains the same.



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### 12 V 14 A electrical ignition, diagram with voltage regulator, battery recharge lamp and manostat

#### Components:

- 1 Alternator
- 2 Starting motor
- 3 Voltage regulator
- 4 Battery
- 5 Oil pressure switch
- 6 Oil pressure lamp
- 7 Ignition switch
- 8 Battery recharge lamp

**Note:** The batteries, which are not supplied by Lombardini, shall have a 12 V voltage and the following capacity:

3LD 450, 3ID 451/S, 3LD 510, 3LD 510/S = 45 Ah  
4LD 640 = 55 Ah  
4LD 705 = 66 Ah  
4LD 820 = 70 Ah

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### 12.5 V 14 A alternator

It is equipped with a fixed rotor assembled on the main journal, while the pivoting rotor is housed inside the flywheel.

#### Dimensions (mm):

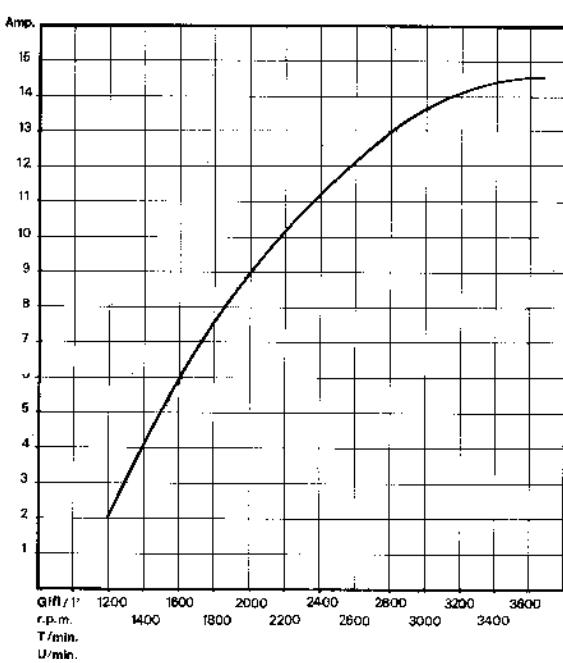
- A = 159  
B = 44.5  
C = 4  
D = 28.5

**Note:** The clearance between inductor and rotor (air gap) shall be 0.5 ÷ 0.6 mm.

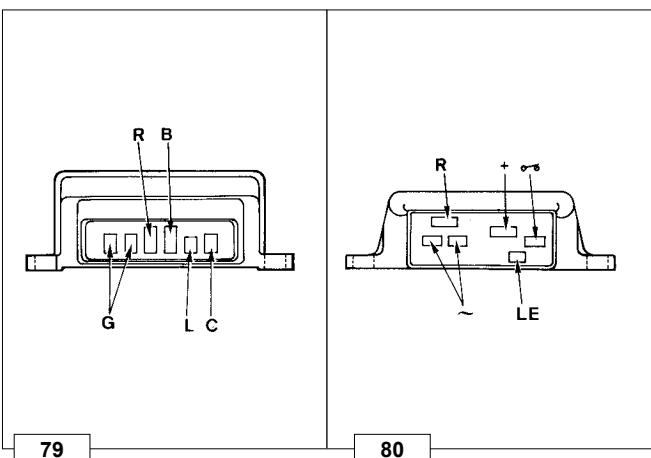
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### 12.5 V, 14 A alternator battery recharge curve

It is carried out at + 25° C ambient temperature, 12.5 V battery voltage.



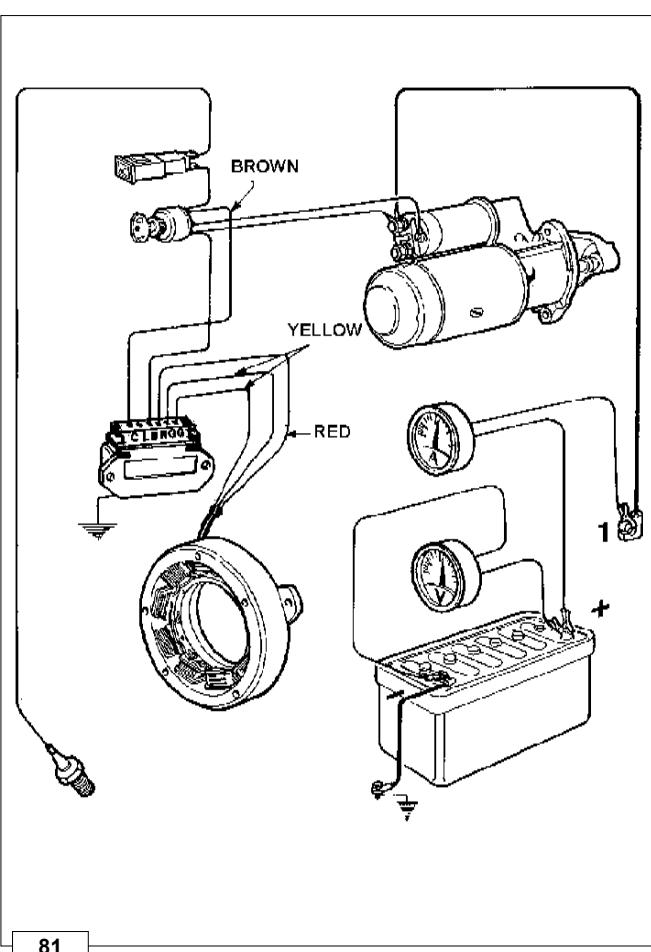
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### Voltage regulator

There are two different types of regulators: one with make SAPRISA, ALTECNA, NICSA and the other with make DUCATI.

ALTECNA SAPRISA NICSA	Cable Colours	DUCATI	Tab dimensions	
			Width	Thickness
~	giallo	G	6,25	0,8
R	rosso	R	9,50	1,2
+	rosso	B	9,50	1,2
LE	verde	L	4,75	0,8
	marrone	C	6,25	0,8



### Voltage regulator, running check

Make sure that the connections are in compliance with the diagram.

Remove the respective clamp from the battery positive pole.  
Insert a voltmeter with direct current between the two poles of the battery.

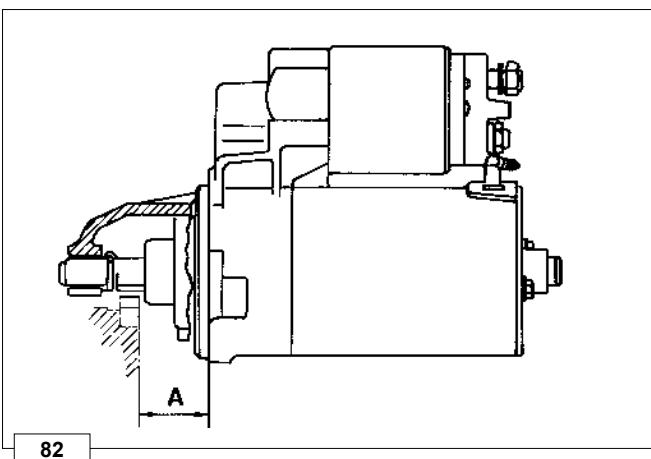
Connect a 20A ammeter at direct current between the positive pole and cable 1 respective clamp.

Start a few times until the battery voltage goes down to 13 V.  
When the battery voltage reaches 14.5 V, the ammeter current will drop to a value near zero.

If the voltage is lower than 14 V and the recharge current is zero, replace the regulator.

**Note:** The voltage regulator does not work when not earthed and the battery is completely discharged.

**Warning:** when the engine runs, do not remove the battery cables and do not take the key off the control board.  
Do not place the regulator near heat sources, a temperature exceeding 75° C could cause damages.  
Avoid any electric welding either on the engine and on the equipment.



### Bosch DW (L) 12 V 1,1 KW type, starting motor

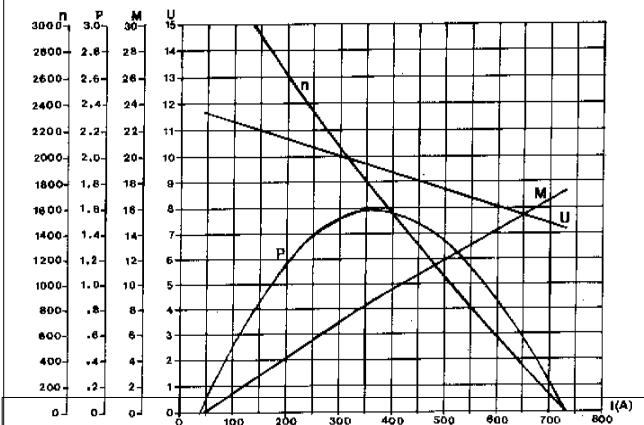
For 3LD 450, 3LD 510

Anticlockwise rotation direction (seen from the flywheel side)

A = 29.5 ÷ 31.5 mm (rim surface and motor flange distance)

**Note:** For any possible repairs, please contact bosch service centres.

Characteristic curves for Bosch DW(L) 12V 1.1 kW type, starting motor



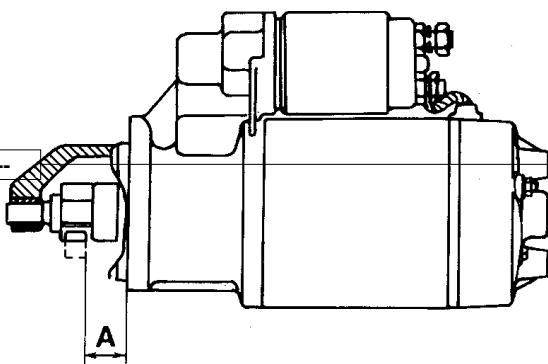
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#### Bosch JF(L) 12V 2.5 kW type, starting motor

For 4LD 640, 4LD 705, 4LD 820

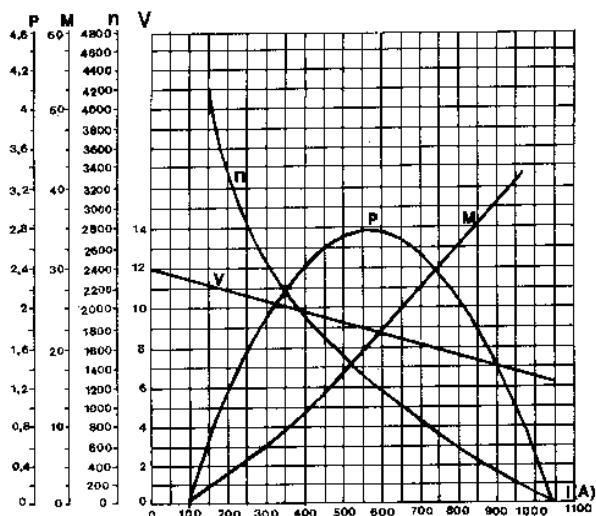
Anticlockwise rotation (seen from the pinion side)

$$A = 23 \div 25 \text{ mm}$$

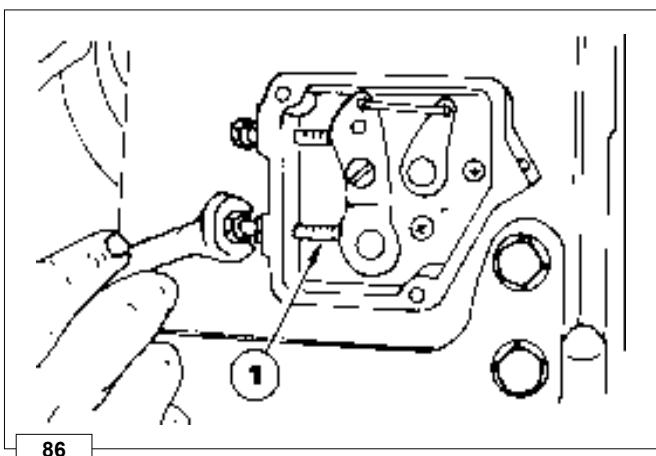


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#### Characteristic curves for Bosch JF(L) 12V 2.5 kW type starting motor



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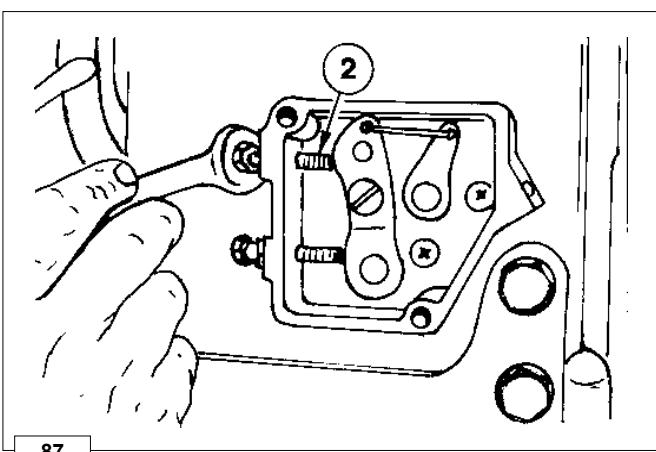


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#### Minimum rpm adjustment at idle running (standard)

After filling the engine with oil and fuel, start and warm up the engine for 10 minutes.

Actuating the adjusting screw 1, set the idling at 1150 rpm; then fasten the lock nut.

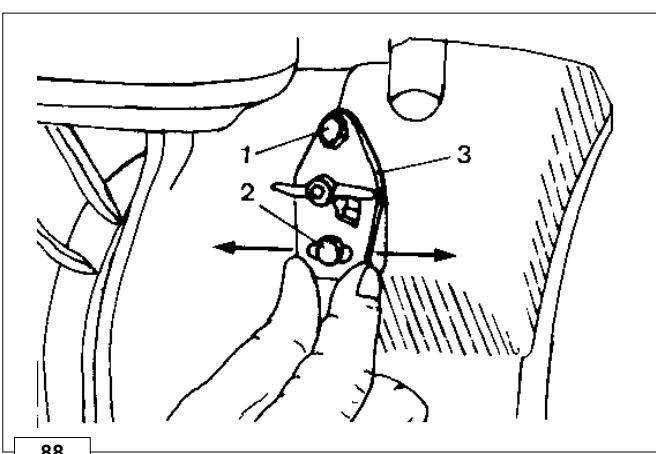


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#### Peak rpm adjustment at idle (standard)

After adjusting the minimum rpm, set the screw 2 and adjust the peak rpm at 3200 rpm at idle; then fasten the lock nut.

**Note:** The peak rpm standard idle adjustment of 4LD 820 shall be carried out at 2800 rpm.



88

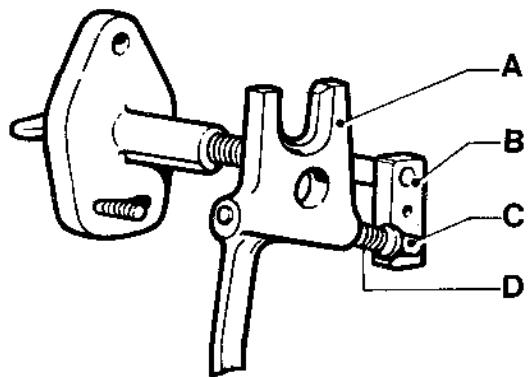
#### Injection pump delivery adjustment (standard)

This adjustment shall be carried out with the engine at dynamometric brake, otherwise the resulting adjustment could be approximate; in this case operate as it follows.

- Unloose the screws 1 and 2 by 1/4 of a turn
- Move the limiting device 3, thus the screw 2 stays in the centre of the slot. Tighten the screws 1 and 2.

#### Carry out the exhaust smoke check as it follows:

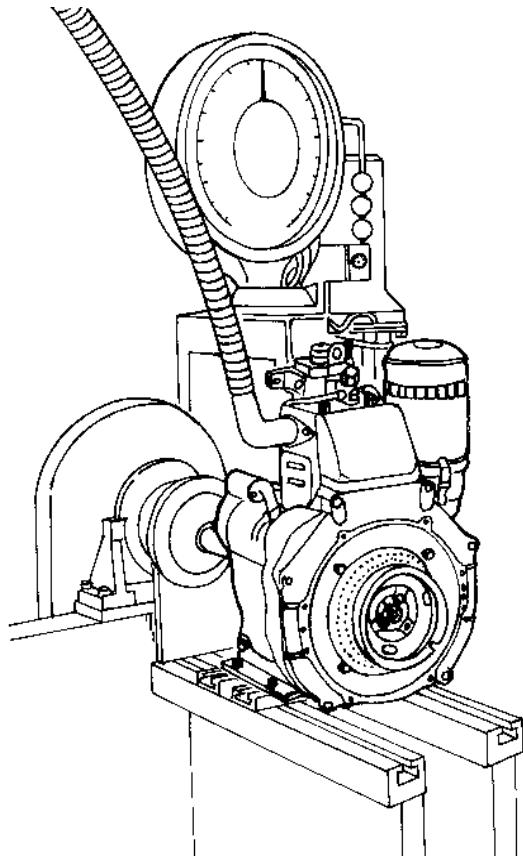
- Abruptly start the accelerator at idle.  
In case of a quick pickup with light exhaust smoke to the Bosch scale index 3, this means that the limiting device is correctly adjusted.
- In case of a slow pickup without smoke, move the limiting device towards the left (pumping duration increase).
- In case of a rapid pickup with thick smoke (exceeding index 3 of Bosch scale), move the limiting device towards the right (pump duration decrease).



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#### Limiting device for injection pump delivery and torque gearing device

It is housed in the pump control lever **A** and it is constituted of a spring on cam **B**, limiting the stroke of the same lever **A**. At the torque rate, the spring flexure, subject to the accelerator control action, allows a further stroke of lever **A**, thus an increased delivery of the injection pump.



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#### Adjustment of injection pump delivery with braked engine

- 1) Bring the engine to its idling point .
- 2) Move the delivery limiting device 3 towards the left, see picture 88
- 3) Operate the engine until it reaches the power and rpm required by the manufacturer of the equipment.
- 4) Make sure that the consumption is in compliance with the values specified in the table of the adjustments (see information below).  
If the consumption is in compliance with the fixed values, it is essential to change the balance conditions measured on the brake, operating either on the load and on the regulator.  
When the engine is steady, carry out the consumption check again.
- 5) Move the limiting device 3 towards the right, as per picture 88, until the engine rpm number decreases. Lock the limiting device by means of the two screws.
- 6) Completely release the brake and check the rpm at which the engine settles. The speed governor performances shall be in compliance with the class required by the manufacturer of the equipment.
- 7) Stop the engine.
- 8) When the engine is cold, check the valve clearance again.

#### Required adjustments (the most demanded)

Engine	Rpm	Kw power	Specific fuel consumption *	
			Time secs for 100 cc.	r/kW.h
3LD 450	3000	N 7,5	140-146	272-283
3LD 450	3600	NB 7	143-149	285-299
3LD 510	3000	N 9	117-122	272-283
4LD 640	3000	N 10,5	96-100	284-295
4LD 705	3000	N 10,8	96-100	276-287
4LD 705	2600	N 10	108-113	263-277
4LD 820	2600	N 12,1	87-92	258-273

\* The specific consumption values indicated are valid after abt. 100 working hours.

- If the engine is not to be used for extensive periods, check the storage area conditions and the type of packaging and make sure that these are suitable for correct storage.
- If necessary, cover the engine with a proper protective sheet.
- Avoid storing the engine in direct contact with the ground, in environments that are humid and exposed to bad weather, near high voltage electric lines, etc.

 If, after the first 6 months, the engine is still not used, it is necessary to carry out a further measure to extend the protection period (see "Protective treatment").

## PROTECTIVE TREATMENT

- 1 - Pour in the engine housing AGIP RUSTIA C protective oil up to the maximum level.
- 2 - Fill up with fuel containing 10% AGIP RUSTIA NT.
- 3 - Start the engine and keep it idle at minimum speed for some minutes.
- 4 - Bring the engine to  $\frac{3}{4}$  of the maximum speed for 5÷10 minutes.
- 5 - Turn off the engine.
- 6 - Empty out completely the fuel tank.
- 7 - Spray SAE 10W on the exhaust and intake manifolds.
- 8 - Seal the exhaust and intake ducts to prevent foreign bodies from entering.
- 9 - Thoroughly clean all external parts of the engine using suitable products.
- 10 - Treat non-painted parts with protective products (AGIP RUSTIA NT).
- 11 - Loosen the alternator/fan belt (if present).
- 12 - Cover the engine with a proper protective sheet.

 In countries in which AGIP products are not available, find an equivalent product (with specifications: MIL-L-21260C).

 Maximum every 24 months of inactivity, the engine must be started up by repeating all "Engine Storage" operations.

## PREPARING THE ENGINE FOR OPERATION AFTER PROTECTIVE TREATMENT

After the storage period and before starting up the engine and preparing it for operation, you need to perform certain operations to ensure maximal efficiency conditions.

- 1 - Remove the protective sheet.
- 2 - Remove any sealing devices from the exhaust and intake ducts.
- 3 - Use a cloth soaked in degreasing product to remove the protective treatment from the external parts
- 4 - Inject lubricating oil (no more than 2 cm<sup>3</sup>) into the intake ducts.
- 5 - Adjust the alternator/fan belt tension (if present).
- 6 - Turn the engine manually to check the correct movement and smoothness of the mechanical parts.
- 7 - Refill the tank with fresh fuel.
- 8 - Make sure that the oil is up to the maximum level.
- 9 - Start the engine and after some minutes bring it to  $\frac{3}{4}$  of the maximum speed for 5-10 minutes.
- 10 - Turn off the engine.
- 11 - Remove the oil drain plug (see "Oil replacement") and discharge the AGIP RUSTIA NT protective oil while the engine is hot.
- 12 - Pour new oil (see "Table of lubricants") up to the maximum level.
- 13 - Replace the filters (air, oil, fuel) with original spare parts.

 Over time, a number of engine components and lubricants lose their properties, so it is important considering whether they need replacing, also based on age (see Replacement table).

 Maximum every 24 months of inactivity, the engine must be started up by repeating all "Engine Storage" operations.

**3LD 450 - 3LD 510 - 3LD 450/S - 3LD 510/S MAIN DRIVING TORQUES**

POSITION	REFERENCE ( Picture NO. )	Dia. /Pitch ( mm )	Torque ( Nm ) 40
Injection pump union	71	18x1.5	30
Connecting rod	36	8x1.25	250
Clutch bearing bell bolt	-	14x1.5	25
Flanging bell	-	8x1.25	80
Clutch bell (industrial engine)	-	16x1.5	20
Rocker arm box cap	8	8x1.25	10
Oil sump	-	6x1	30
Oil pump case	58	8x1.25	25
Air filter	1	8x1.25	25
Oil filter	-	8x1.25	20
Oil pump gear	58	8x1.25	15
Injector towards the head	75	8x1.25	60
Rocker arm fulcrum pin for injection pump	-	14x1.5	40
Gear pin for speed governor	-	10x1.5	40
Engine foot	-	8x1.25	25
Injection pump	69	8x1.25	25
Distributor side port	40	8x1.25	35
Oil pressure switch	-	12x1.5	35
Starting pulley	4	8x1.25	25
Main bearing on flywheel side	63	8x1.25	35
Sump oil drain bolt	-	10x1.5	50
Cylinder	14	10x1.5	170
Flywheel	3	20x1.5	

**MAIN DRIVING TORQUES 4LD 640 - 4LD 705 - 4LD 820**

POSITION	Reference ( picture no.)	Dia. / Pitch ( mm )	Torque ( Nm )
Injection pump unit	71	18x1.5	40
Connecting rod	36	10x1.5	45
4LD 820 clutch bearing bell bolt	-	14x1.5	280
4LD 640, 4LD clutch bearing bell bolt	-	14x1.5	250
Bolt for hub	-	14x1.5	280
Flanging bell	-	10x1.5	40
Rocker arm box cap	8	8x1.25	20
Oil sump	-	8x1.25	25
Oil pump case	58	8x1.25	40
Air filter	1	10x1.5	50
Oil filter	-	8x1.25	25
Oil pump gear	58	8x1.25	20
Injector towards the head	75	8x1.25	20
Rocker arm pin for injection pump control	-	8x1.25	30
Gear pin for speed governor	-	10x1.5	40
Engine foot	-	10x1.5	40
Injection pump	69	8x1.25	30
Distributor side port	41	10x1.5	40
Oil pressure switch	-	12x1.5	35
Starting pulley	4	10x1.5	40
Main bearing on flywheel side	64	10x1.5	40
Sump oil drain bolt	-	14x1.5	70
Cylinder head	14	12x1.5	80
Flywheel	3	20x1.5	350

**Table of tightening torques for standard screws (coarse thread)**

Quality/ Dimensions	Resistance class (R)											
	4.6	4.8	5.6	5.8	6.8	8.8	10.9	12.9				
Diameter	R>400N/mm <sup>2</sup>		R>500N/mm <sup>2</sup>		R>600N/mm <sup>2</sup>		R>800N/mm <sup>2</sup>		R>1000N/mm <sup>2</sup>		R>1200N/mm <sup>2</sup>	
	Nm	Nm	Nm	Nm	Nm	Nm	Nm	Nm	Nm	Nm	Nm	
M3	0,5	0,7	0,6	0,9	1	1,4	1,9	2,3				
M4	1,1	1,5	1,4	1,8	2,2	2,9	4,1	4,9				
M5	2,3	3	2,8	3,8	4,5	6	8,5	10				
M6	3,8	5	4,7	6,3	7,5	10	14	17				
M8	9,4	13	12	16	19	25	35	41				
M10	18	25	23	31	37	49	69	83				
M12	32	43	40	54	65	86	120	145				
M14	51	68	63	84	101	135	190	230				
M16	79	105	98	131	158	210	295	355				
M18	109	145	135	181	218	290	405	485				
M20	154	205	193	256	308	410	580	690				
M22	206	275	260	344	413	550	780	930				
M24	266	355	333	444	533	710	1000	1200				
M27	394	525	500	656	788	1050	1500	1800				
M30	544	725	680	906	1088	1450	2000	2400				

**Table of tightening torques for standard screws (fine thread)**

Quality/ Dimensions	Resistance class (R)											
	4.6	4.8	5.6	5.8	6.8	8.8	10.9	12.9				
Diameter	R>400N/mm <sup>2</sup>		R>500N/mm <sup>2</sup>		R>600N/mm <sup>2</sup>		R>800N/mm <sup>2</sup>		R>1000N/mm <sup>2</sup>		R>1200N/mm <sup>2</sup>	
	Nm	Nm	Nm	Nm	Nm	Nm	Nm	Nm	Nm	Nm	Nm	Nm
M 8x1	10	14	13	17	20	27	38	45				
M 10x1	21	28	26	35	42	56	79	95				
M 10x1,25	20	26	24	33	39	52	73	88				
M 12x1,25	36	48	45	59	71	95	135	160				
M 12x1,5	38	45	42	56	68	90	125	150				
M 14x1,5	56	75	70	94	113	150	210	250				
M 16x1,5	84	113	105	141	169	225	315	380				
M 18x1,5	122	163	153	203	244	325	460	550				
M 18x2	117	157	147	196	235	313	440	530				
M 20x1,5	173	230	213	288	345	460	640	770				
M 20x2	164	218	204	273	327	436	615	740				
M 22x1,5	229	305	287	381	458	610	860	1050				
M 24x2	293	390	367	488	585	780	1100	1300				
M 27x2	431	575	533	719	863	1150	1600	1950				
M 30x2	600	800	750	1000	1200	1600	2250	2700				

### USE OF DOPE FOR 3LD 450 - 3LD 510 - 3LD 451/S - 3LD 510/S

POSITION	TYPE OF SEALANT
Clutch bearing bell and embedded hexagonal-head screws	LOCTITE 270
Control pin threading	LOCTITE 270
Coupling nipple for oil filter cartridge	LOCTITE 270
Stud bolt for clamping on engine head	LOCTITE 270
Stud bolt for clamping on main bearing flywheel side	LOCTITE 270
Stud bolt for clamping on distributor port side	LOCTITE 270
Stud bolt on engine bell	LOCTITE 270
Clamping screw for pin regulator	LOCTITE 270
Clamping screw for baffle on air conveyor	LOCTITE 270
Stud bolt for clamping on engine flange bell	LOCTITE 270
Rocker arm fulcrum pin for injection pump control	LOCTITE 270
Bracket clamping screw on side plates	LOCTITE 270
Stud bolt for clamping at feeding pump	LOCTITE 270

### USE OF DOPE FOR 4LD 640 - 4LD705 - 4LD 820

POSITION	TYPE OF SEALANT
Bearing on port or bell	LOCTITE 270
Regulating pin threading	LOCTITE 270
Stud bolt for clamping on engine head	LOCTITE 270
Stud bolt for clamping on main bearing on flywheel side	LOCTITE 270
Stud bolt for clamping on distribution side	LOCTITE 270
Lock screw for rocker arm pin	LOCTITE 270
Clamping screw for regulating pin	LOCTITE 270
Industrial port	DOW CORNING Q3 - 7091SILICONE
Stud bolt for clamping on feeding pump	LOCTITE 270









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## WORKSHOP MANUAL

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